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the glass industry

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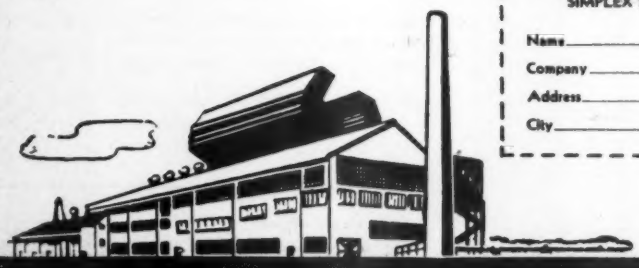

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the glass industry
VOLUME 36, NUMBER 5, MAY, 1955

The Determination of Calcium in Glass by Flame Photometry

By DAVE BILLINGS

Glass Containers Inc., Los Angeles, Calif.

Abstract

Several schemes for the rapid chemical analysis of silicates have been proposed. Sodium and potassium have been successfully determined in glass by flame photometry. Two procedures for determining calcium by flame were tried. The interference of aluminum on the calcium emission was eliminated. Other interfering ions were either removed or compensated for.

The routine determination of calcium in glass is by the titration of the oxalate by permanganate.[1] When sodium and potassium are determined by flame photometry from a 100 milligram sample, however, it is inconvenient to prepare a special glass sample for the calcium determination. It has been suggested that calcium can be determined in glass by flame if interfering ions are either removed or compensated for.[2] Two procedures were tested: (a) a method in which the calcium standards were carried through exactly the same procedure as the unknowns and (b) a method in which calcium in the unknown is precipitated as the oxalate, redissolved and compared to standards containing calcium in dilute HCl solution.

Instrumentation

The Beckman Model B Spectrophotometer with flame attachment, Model 9125, and using the acetylene burner was used. A ratheon voltage stabilizer was used to reduce line voltage fluctuations. The photomultiplier assembly was used in all tests at a setting of "E" (at this sensitivity, a slit width of 0.1 mm-0.2 mm could be used for samples containing approximately 100 ppm CaO). The sensitivity knob was set at "4," fuel pressure 3.5 pounds, oxygen pressure 15 pounds and the wavelength set at 622 mu.

One of the principal sources of error in the calcium determination is the instability of the instrument. Two important sources of instability are flame fluctuations and "noisy" phototubes. It was found that the calcium solutions caused clogging of the burner and that flushing the burner with distilled water after each day of use reduced the erratic flame behavior. Much difficulty was experienced in making flame determinations with the standard blue phototube because of "noisy" tubes and slow tube response. With the photomultiplier tube, however, a much more rapid and stable response can be obtained.

Effect of Sample Preparation on Calcium Emission

When calcium carbonate samples are dissolved in dilute HCl, the emission readings plotted against concentrations give a straight line (Table I) in the range 5 ppm-120 ppm CaO. When glass samples of known calcium content are digested with HF and $HClO_4$, however, the calcium emission is not that of the known amount of calcium present. The presence of aluminum depressed the calcium emission, digestion by HF and $HClO_4$, and the addition of NH_4Cl (used in the removal of aluminum by precipitation as the hydroxide) enhanced the calcium flame (Table II and III).

Procedure

(a) Interfering ions are compensated by carrying the standards through the same procedure as the unknowns.

Standard calcium solution, 2.4970 gms. reagent grade

Table I

Typical Data for Calcium Standard Curve

CaO Present ($CaCO_3$ in Dil. HCl) *	*% T at 622 mu*
0 ppm	4.0
14.0 ppm	11.8
28.0 ppm	16.1
42.0 ppm	22.2
70.0 ppm	33.0
98.0 ppm	46.0
112.0 ppm	50.0

*$CaCO_3$ and aluminum metal dissolved in a minimum quantity of HCl

Table II

Effect of Sodium on Calcium Flame Emission

CaO Present	*%T ($CaCO_3$ in Dil. HCl)*	*%T ($CaCO_3$ in dil HCl + 148 ppm. Na_2O)*
22.4 ppm	9.2	13.3
44.8 ppm	19.5	23.3
67.2 ppm	30.0	31.0
89.6 ppm	40.0	40.1
112.0 ppm	50.0	50.0

Table III

Effect of Various Ions on Calcium Flame Emission

	ppm CaO	*%T*
$CaCO_3$ in dil HCl	112.0	50.0
$CaCO_3$ evap. with HF & $HClO_4$	112.0	73.5
$CaCO_3$ in dil. HCl + 1.00 gm NH_4 Cl/100 ml	112.0	67.0
Ca precipitated as oxalate and redissolved in dil HCl	112.0	50.0
$CaCO_3$ in dil HCl	70.0	30.0
$CaCO_3$ in dil HCl + 3 ml 1 N HCl neutralized with NH_4OH (1:2)	70.0	37.2
$CaCO_3$ in dil. HCl evap. with two 2 ml portions of $HClO_4$ (70%)	70.0	45.0
$CaCO_3$ in dil HCl + .5 mg Al per 100 ml	70.0	29.0
$CaCO_3$ in dil HCl + 1.0 mg Al per 100 ml	70.0	25.7
$CaCO_3$ in dil HCl + 1.5 mg Al per 100 ml	70.0	22.3

$CaCO_3$ dissolved in dilute hydrochloric acid and diluted to one liter (1.000 mg Ca per ml).

Standard sodium solution, 1.000 gm. reagent grade NaCl dissolved in H_2O and diluted to 250 ml (2240 ppm Na_2O).

Standard potassium solution, 1.000 gm reagent grade KCl dissolved in H_2O and diluted to 250 ml (2525 ppm K_2O).

18 ml standard calcium solution, 17 ml of standard sodium solution and 1 ml of standard potassium solution are measured into a platinum dish. 5 ml reagent grade hydrofluoric acid (48%) and 2 ml reagent grade perchloric acid (70%) are added to the dish and the solution is evaporated almost to dryness. 2 ml perchloric acid is added and the standard is evaporated to no further perchlorate fumes. The residue is taken up with 3 ml 1 N hydrochloric acid and transferred to a 250 ml volumetric flask. 1.00 gm reagent grade NH_4Cl is added and the solution is diluted to the mark with water. This solution contains 100.8 ppm CaO, 144.2 ppm Na_2O and 10.0 ppm K_2O. This solution contains approximately the same concentration of calcium, sodium and potassium as the solution prepared from 100 mg. of soda lime glass in 100 ml. This solution is used to set up the instrument at the proper wavelength and slit width and then as a direct comparison with each unknown. For the preparation of the standard curve, a series of standards is prepared as described above with sodium and potassium content being held constant and calcium content varied. The low K_2O content of this solution does not affect the calcium emission measurably, but this solution may be used as a standard for potassium. A standard curve is prepared from the standard solutions transmittance data. 100 ppm CaO is set approximately 50% transmittance so that the most accurate range of the instrument is utilized for the routine determinations.

Preparation of the unknown for analysis: 0.1000 gm of finely powdered glass is weighed into a platinum dish. 2 ml reagent grade perchloric acid and 5 ml reagent grade hydrofluoric acid are added to the dish. The sample is evaporated almost to dryness on a hotplate at 150°C. Two more ml of perchloric acid are added and the sample is evaporated until no further fumes of perchloric acid are evolved. The residue is taken up with 3 ml 1 N hydrochloric acid and transferred to a 30 ml centrifuge tube.[3] Several drops of bromcresol purple indicator solution are added and 1:4 ammonia is added until a yellow color is reached. Stirring is accomplished with an air jet stirrer. The $R(OH)_3$ precipitate is then concentrated in the bottom of the centrifuge tube by centrifuging for 5 minutes at 1800 R.P.M. The supernatant liquid can conveniently be drawn off from the precipitate into a 100 ml volumetric flask with suction. The precipitate is washed with water, again centrifuged and the wash water is drawn into the volumetric flask. The solution is diluted to the mark with water.

With the spectrophotometer set up as described under standard curve preparation above, the 100.8 ppm CaO standard is introduced into the flame. Transmittance is then adjusted to the proper point by slit width setting. The unknown is compared to the standard several times to insure a reliable reading. Ca content is then determined from the standard curve.

(b) Interfering ions are removed.

Appropriate calcium solutions are made up by diluting standard calcium solution (1.000 mg. Ca per ml), with water. The standard curve is prepared from flame emission data of these standards.

The unknowns are treated the same as in the method described above up to the precipitation of $R(OH)_3$. After centrifuging, the $R(OH)_3$, the supernatant liquid is drawn off into a 50 ml centrifuge tube. The wash liquid (35 ml washings) is added to the same tube. The calcium is then precipitated and centrifuged by the method of Kingsley and Schaffert.[4] After draining the liquid from the calcium oxalate, the precipitate is dissolved in dilute hydrochloric acid, diluted to 100 ml and compared with a standard solution of calcium prepared as described under "b" above.

An alternate method for separation of $R(OH)_3$ and calcium oxalate is by filtering these precipitates through the standard papers for these precipitates. In using this procedure, the calcium oxalate on the filter paper can be transferred to a small beaker and redissolved in dilute hydrochloric acid. The oxalate precipitate should be treated with two separate portions of hydrochloric acid in order to get complete solution. This procedure proved more reliable than the separation by centrifuging and was equally rapid.

Accuracy

With careful work, an accuracy of ±2% should be obtainable with both of the procedures listed above. If a large sample of glass is pulverized, thoroughly mixed and dried, then the principal sources of error are in interfering ions in the flame procedure and inherent error of the flame photometer.

(*Continued on page* 280)

Photos by David Shore.

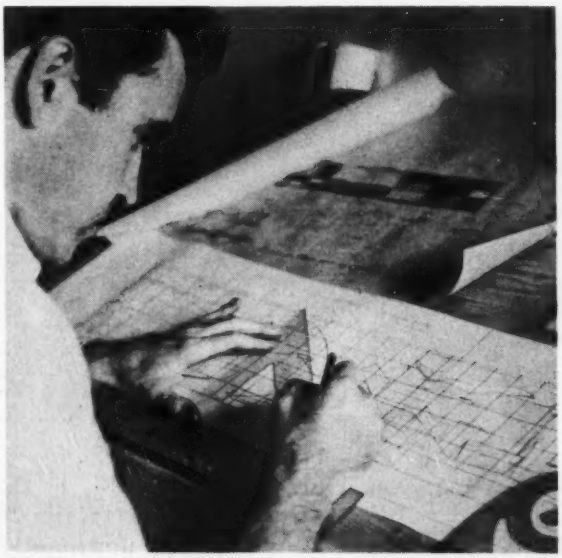
Glass Mosaic Mural Feature of Los Angeles Civic Center

● WHEN THE NEW $6,000,000 Los Angeles Police Facilities Building in the Civic Center opened for public view in May, one of the focal points of interest was the world's largest glass mosaic mural ever to be executed by an American artist.

The mural, which "hangs in space" in the lobby of the building, was designed and made by Joseph L. Young, American artist who received his training in Europe from world-famous muralists. The building was designed by the noted architectural firm of Welton Becket, F.A.I.A., and Associates in association with J. E. Stanton, architect.

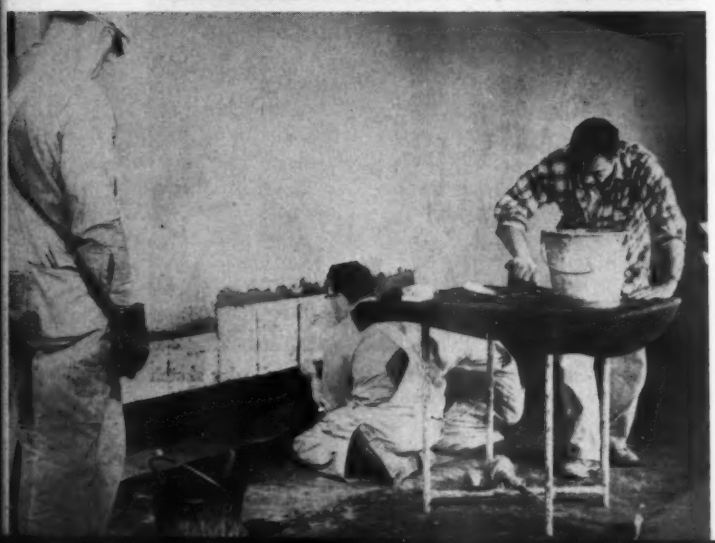
The monumental mosaic mural, 36 feet long and six feet high, is the first major work of this type in the world to depart from conventional installation in the wall or floor. The mural is comprised of more than a quarter of a million tiny glass stones (called "tesserae"), each piece set by hand. The tesserae was imported from Italy, especially prepared by Venetian glassmakers according to Mr. Young's specifications. More than 50 diverse colors were used by the artist. Basically, the glass tesserae are exactly the same as the mosaic used in the famed Byzantine cathedrals of Monreale, Ravenna, Constantinople, etc. Special lighting was worked out in collaboration with Rudolph Wendel, Inc., of Los Angeles & New York, to assure that the mural will act as a secondary source of illumination in the lobby at night.

As executed, the mural is cantilevered from two supporting columns in the main lobby of the building. It serves as a divider-partition between the spacious lobby and the public telephone area. The front side of the mural contains the design, a colorful panoramic theme of Los Angeles, dedicated to its phenomenal architectural growth. The back side of the mosaic, which is finished in monotone colors of the hand-set tesserae, serves as a panel to



Detailing of scale cartoon, 1" equals 1', after final color sketch was approved.

The mural was broken down into over 430 sections, carefully packed for transportation to the installation site of the main lobby of the Los Angeles Police Facilities Building; then carefully reassembled in a layout directly in front of the cantilevered panel.



support the public telephones which are actually installed in the cantilevered mural.

The artist spent two years in the creation of this mural which weighs six tons. Prior to this time, large murals have been sent to Italy for execution. This is the first architectural mosaic of this size in America to be personally executed by the American muralist who designed it and is also the first to be cantilevered from the supporting columns.

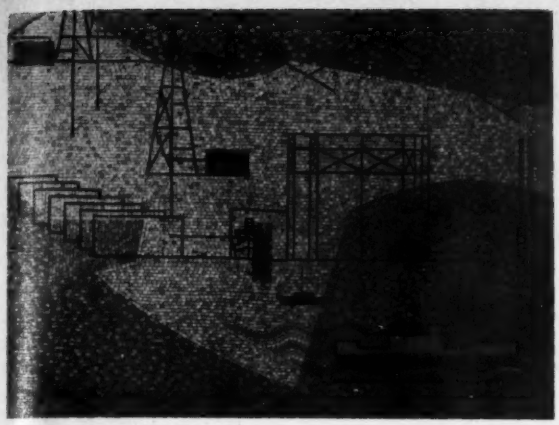
The artist has created a design that reveals the history of Los Angeles as seen on a sunny day. Interlocking images that move down the panel show a technique of crisp black outlines superimposed over a rhythmic background of abstract shapes. Among the famous landmarks included in the work are the City Hall, Grauman's Chinese Theatre, oil wells on Baldwin Hills, Los Angeles Harbor and the industrial area. The Growth of Los Angeles is symbolized by the freeway cloverleaf near Civic Center. Old street cars are contrasted with modern trackless trolleys. Business is spotlighted by Miracle Mile with the Prudential Life Insurance Company building against the skyline. History is reflected in the Alemeda Street Mission

Top to bottom:

Artist handcutting tiny individual imported Italian glass tesserae. One-quarter million tesserae were cut, for which Mr. Young designed the improved cutting stand.

Laying the individual glass tesserae on one section. Here a special water-soluble mastic was employed so that stones were securely anchored onto the paper. This mastic was especially developed by Mr. Young to withstand the long dry spells of the Southern California climate.

Installation proceeds in rows of one foot sections placed from left to right. Note the dark cement grout applied in advance of the installation of the sections and how the foreman's assistant squeezes additional grout in between stones before applying this piece to mortar surface.



Detail of lower left-hand corner, with artist's signature in mosaic.

Detail of mosaic mural laid out on floor with bottom sections already removed and installed.

Church, while science is recognized with Griffith Park Observatory. Angel's Flight, UCLA's Royce Hall, both traditional and modern homes, are also part of the mural's story.

Of the six tons of glass and concrete in the mural, approximately one ton is glass and the remaining five tons are steel frame, copper lathe, concrete setting bed, telephone conduits on rear of mural, and aluminum framing. The entire design of the mural is in glass mosaic, over 432 square feet, and represents two years of patiently handsetting and cutting ¼ million tiny individual tesserae and mounting them on paper in reverse.

The 250,000 tiny glass tesserae, each handcut to the required size of the specific space in the design, were set in place in the artist's studio and mounted on paper. These sections were carefully moved from the artist's studio to the Police Building and installed on the cantilevered wall. The special achievement of Joseph Young in this work is that the "seams" from one section to another are invisible.

The mural was set in a special cement formulated by the artist to withstand the particular climatic conditions of Los Angeles and to eliminate any possibility of mosaic pieces falling from the mural because of heat or lack of moisture in the air.

Although the mural will last for hundreds of years, no maintenance will ever be required. If cleaning is necessary, a garden hose may be used to wash down any dust accumulation. Brushed aluminum is used for the framing to surround the mural which is about five inches thick. Steel I-beams are used to attach the mural to the structural columns.

The artist, a native of Pittsburgh, Pa., studied journalism and worked for one of the major wire services in New York City before he entered the Army Air Forces in 1943. Following his discharge in 1946, he decided to pursue the study of mural art. His scholarships and study took him to Mexico and Europe, as well as to outstanding art schools in this country. The Police Facilities mosaic mural is the subject of a 16mm Kodachrome documentary film being produced in cooperation with the University of California at Los Angeles and will be the first film ever to record the "creative process" in making mosaics.

GORDON RESEARCH CONFERENCES: GLASS

The Gordon Research Conferences, AAAS, were established to stimulate research in universities, research foundations and industrial laboratories. This purpose is achieved by an informal type of meeting consisting of scheduled lectures and free discussion.

A Gordon Research Conference on Glass, of which F. C. Flint is Chairman, has been scheduled for August 15 through 19. Held at the University of Rhode Island, Kingston, Rhode Island, the attendance at each Conference is limited to 100.

The program for the coming Glass Conference is as follows: *August 15, Structure of Non-Crystalline Condensed Phases I*: F. C. Flint, Chairman; "New Concepts of Glass Structure," W. A. Weyl; "The Polymer Theory of Glass Structure," J. R. Van Wazer; "Electron Configuration in Structural Interpretation of Some Glass Properties," E. Plumat; "Current Japanese Concepts of Glass Structure," I. Sawai. *August 16, Structure of Non-Crystalline Condensed Phases II:* N. J. Kreidl, Chairman; "Structural Significance of Low T Heat Capacity Data for Silica," S. W. Barber; "Theory of Viscous Flow in Glasses," H. T. Smyth; "Concepts of Glass Structure Bases on Physical Properties and Electron Micrographs," J. W. Michener; "The Frozen Equilibrium Theory of the Vitreous State." W. J. Kauzman. *August 17, Transformation Phenomena (2nd Order Transition)*: O. L. Anderson, Chairman; "Transition Pheonomena in Glass," H. R. Lillie; "Some French Views of Transition Phenomena," N. M. Brandt; "The Continuous Transition in Glass Polymers," T. G. Fox, Jr.; "The Glassy Transition in Polymers," A. V. Tobolsky. *August 18, Sonic and Pressure Effects on Glass Structure:* H. R. Lillie, Chairman; "The Use of Ultrasonics in the Investigation of Glass Structure," T. H. Litovitz; "Irreversible Density Changes of Glass Under High Pressure," I. Simon; "Reversible Density Changes of Glass Under High Pressure," O. L. Anderson, *August 19:* Resume and Conclusions, E. U. Condon.

Meeting Reports

- Optical Society of America
- Inter-Society Color Council

Optical Society of America
Spring Meeting

The Optical Society held its Spring Meeting at the Statler Hotel in New York, April 7, 8 and 9, 1955. The program was a little thinner than usual, and one wonders whether people are too busy to write papers or whether the fact that it was Holy Week had any effect.

The sessions were opened by five invited papers. The first four had to do with spectrographic studies, and discussed work on simple polyatonic molecules, polymer molecules, proteins and dyes. Your reporter mentions them only, since they bear seemingly little relation to glass.

The next session opened with the invited paper, "Optical Instrumentation for Examination of the Eye" by Donald M. Donaldson of Harvard University and Massachusetts General Eye and Ear Infirmary. This paper described a camera with which it was possible to take stereoscopic pictures, in color, of disorders of the cornea, lens and disturbances within the eye. The advantages of the instrument were that pictures could be taken of people where cooperation (babies) could not be obtained for prolonged examination. The films could then be examined at leisure. Dr. Donaldson had viewing equipment set up for illustrating some of the disorders found. The pictures were very good, though somewhat gruesome. It would appear that this may become a very useful tool. This paper was followed by one by Louise L. Sloan, "The Haidinger Brush Phenomena," in which an instrument was described which gave a measure of the visibility of the Haidinger brushes. The effects of various visual impairments were discussed with relation to the observed results. The equipment was available for the convention to try.

In a paper "A Method for Measuring Veiling Glare," J. H. McLeod described an instrument for measuring the "flare" in a lens which may be due to scratches, dirty surfaces or to the lens itself. The apparatus described was simple and gave results at various angles. The discussion brought out many points, prominent among which was the fact that it is extremely difficult to clean glass samples adequately. Grady T. Hicks, in "A Comparison of Low Luminance Photometers," described some work in which a low luminance photometer using a comparison field of 2042°K color temperature was compared with photocolor. The results of this work indicated that there are no significant differences when the comparison field demeters having self-luminous buttons, which showed some parted from the color of a 2042°K field. This evoked much discussion among those attending this meeting.

"Analysis of Brightness Discrimination Data and Their Application to Photometry" by A. Morris indicated that her work showed variations from operator to operator or from session to session in using the McBeth Illuminometer, but that an adequate number of observations gave accurate estimations of the source. Jo Ann Smith Kinney, in "The Sensitivity of the Eye to Spectral Radiation at Scotopic and Mesopic Intensity Levels," gave spectral sensitivity curves for several intensity levels above the scotopic threshold for small fields. She found that the sensitivity does not change over a range of luminosities and that as intensity increases, the first shift in luminosity curve occurs on the long wavelength arm.

There followed two papers on atmospheric measurements. Robert A. Oetjen, Ely E. Bell, James Young and Raymond Metter reported on their "Infrared Sky Measurements" which were made in Ohio and in Colorado. Carl A. Pearson and Edward A. Boettner reported on "Horizontal Atmospheric Transmittance Measurements with a Thallous Sulfide Cell Transmissometer."

Out of the papers of the simultaneous session, your reporter would have liked to have heard "Effect of Slit Widths and Aberrations on Spectrograph Curves" by Edward Speyer, and the paper of Mark Guttman and F. T. Byrne, "Optimum Slit Width of A Spectrograph," but scheduling prohibited hearing these.

On Friday morning there were a number of papers on appearance, first of which was Eugene Allens, "Colorimetry of Fluorescent Whitening Agents." Dr. Allen described that there were two types of whiteners for adding to detergents, one being described as green and the other as red. His paper described a unique manner of evaluating the efficiency of the whiteners even though their spectrophotometric curves are different. Richard S. Hunter described two pieces of equipment, "Fluorescence-Sensitive Reflectometer" and "Multipurpose Gloss Apparatus." In the first paper he described a 0°-45° reflectometer, which by means of quick change noviol filter it was possible to get measures of reflectance to blue light or to fluorescent light. His second paper described a relatively simple gonionmeter type instrument capable of measuring six recognized types of gloss including distinctness of image and depth of finish types.

W. F. Koehler, in "A New Method of Measuring Roughness," described an interferometer technique for studying surface roughness. The results are presently limited to giving the combined roughness of the sample and a test plate. George M. Wyman described "The Measurement of Solid Samples on the Cary Spectrophotometer" in which solid samples of dyes (sometimes generally insoluble) are suspended in fused KBr which is then allowed to cool. The resulting samples give spectrophotometric data on materials which it has been impossible to measure otherwise. The method, when applied to materials on which there is existing data, do not agree exactly. "Color Control by Ultrasonic Wave Gratings" by A. H. Rosenthal described equipment which they had constructed in which an ultrasonic wave applied to a

crystal acted as a grating when light (wave fronts perpendicular to the sonic wave fronts) shines through it. It was possible to use the system for spectrophotometric measurements, although the present system does not have too much resolution. J. E. Tyler presented a review of the paper, "The Apparent Spectral Radiance of Submerged Objects," in the absence of R. W. Preisendonfer, along with the paper "The Apparent Color of Underwater Objects" by himself and S. Q. Duntley. He described the method of calculation which they had built up which permitted the spectral-radiance distribution of colored objects when viewed underwater. They had plotted the appearance of colors at different distances and these agreed with what is reported by persons who dive.

It was impossible to hear "The Use of a Fabry-Perot Etalon for Spectrophotometry" by Theodore Dunham and "Automatic Background Correction on a Multi-Channel Flame Spectrometer" by Marvin Margoshes and Bert L. Vallee.

Friday afternoon produced a series of papers on color vision. The first was Robert M. Boyntons' "Improved Method for Investigating the Fundamental Response Curves Underlying Human Color Vision." This paper dealt with studies aimed at the fundamental responses of the cone spectral sensitivity curve. By combining stimuli with colored adapting stimuli, it was possible to obtain evidence of four maxima (430 mμ, 530 mμ, 570 mμ, and 610 mμ) and the possibility then of four fundamental response functions of the cones. A similar technique was presented by David L. MacAdam in "Chromatic Adaptation." Dr. MacAdam was dealing with the problem of "projected" color pictures to represent one kind (daylight or tungsten) of illumination when possibly taken by the reverse. He presented some interesting curves which showed the colored matches made when the eye was previously color adapted. The paper, "Luminosity Functions for Normal and Dichromatic Subjects Including a Case of Unilaterial Color Blindness" by C. H. Graham, Y. Hsia, and E. Berger, produced a great deal of discussion, although the discussion seemed largely tied up with definitions of difficiencies of color blindness. Forrest L. Dimmick, in "Specifications and Calibration of the 1953 Edition of the I.S.C.C. Color Aptitude Test," indicated the continued studies of this test indicate that changeability in color matching on the job is related to variability in test matching. He concluded also that a color matcher is not as good as he thinks he is in a particular color match.

Two papers by Leo M. Hurvich and Dorothea Jameson, "Quantitative Aspects of an Opponent-Colors Theory: I Spectral Saturation and Chromatic Responses, II Brightness, Saturation, Hue and Color Specification," left color-interested people talking. Their technique had been worked out to provide separate and direct measures of the chromatic components of saturation discrimination measurements. They had assumed an opponent-colors theory of vision. From this they went on to develop a system of color specification which had uniform psychological spacing. Such a system permitted predicting the color shifts due to illumination and adaptation.

Papers missed at this session were "Determining Oblique Properties of Ophthalmic Lenses" by Glenn Wooters, and M. Herzberger's "Intrinsic Image Error Theory."

In the Saturday session, R. Clark Jones, in "Transmittance of Three Polarizers in Series—A Surprising Result," pointed out that if two dichroic polarizers are set parallel and the incident light is unpolarized, then a third polarizer set between the other two does not necessarily give minimum transmittance when it is crossed to the other two. The cross position can give a relative maximum with minima on each side if the center polarizer has birefringence resulting in elliptically polarized light. Ralph W. Wright presented "Optical Null Tests" in which methods of combining null testing and interference testing on surfaces of revolution were discussed. P. D. Carmen, in "Flattening of Photographic Plates for the Testing of Air Survey Cameras," described a process of bending the ¼-inch plates and observing their flatness with interference fringes in infrared light. The process produces redisual flatness of less than one micron. Kathryn A. McCarthy, Lewis S. Combes, Stanley S. Ballard and Theodore Dunhan, Jr. continued a series started by two of them with "The Thermal Conductivity and Thermal Expansion of Obsidian." Their study was based on the assumption that the supplies of natural material were a possible source of well-annealed reflectors in possibly very large pieces.

At the dinner meeting, Adelbert Ames, Jr. of Hanover, New Hampshire, was awarded the Edgar D. Tillyer award for 1955. This was awarded to Mr. Ames for his outstanding work in the field of vision.

The lecturer at the dinner meeting was Ralph M. Evans who gave another one of his popular lectures on the subject of "Color and Brightness in Projected Color Pictures." Mr. Evans had brought with him a slide projector for some of his slides having illumination of the type used in motion picture cameras and having a very high color temperature. Slides used were sometimes shown with the standard tungsten projector and sometimes with the special projector. The lecture brought out how we quickly become adapted to the color of the illumination in what we see, and went on to show the various effects of color and brightness of the illuminant in the picture we view, and the troubles of the motion picture industry in matching film taken at different times or under different conditions.

Inter-Society Color Council 24th Annual Meeting

The ISCC's 24th Annual Meeting was held Wednesday, April 6, in the Skytop Room of the Statler Hotel. At this time, reports were heard from most of the working committees and from the delegations which comprise this organization. The organization is composed of delegations from such groups as dye chemists, psychologists, gravure and printers, paint, illumination and packaging people, tanners, etc. The reports of the committees are given here briefly:

Color Specifications: This committee submitted a comprehensive final report giving in condensed form the systems of notation, standards, types of instruments and codes in use in this country.

Color Aptitude Test: Although this committee has published a test suitable for testing the color aptitudes of people, it continues to study its results. The test is now available from the MacBeth Co.

Color Blindness: This committee has approved the

(*Continued on page* 282)

The Devitrification Behavior of Glasses Used in Vacuum Techniques

By O. KNAPP

Industrial Research Institute for Telecommunication, Budapest

● GLASS, IN GENERAL, has the characteristic property of crystallizing; that is, devitrifying over a certain range of temperature favorable for this process to take place. This property plays an important part in the manufacture and application of glasses because devitrification causes defects in the finished article.

The tendency to devitrification depends on the chemical composition of the glass. In case of a given constant chemical composition, devitrification is a function of temperature and time. For a given duration of heating, the tendency to devitrify is characterized by the relationship between the rate of crystal growth and temperature. The curve in Fig. 1 shows the following important devitrification characteristics.

T_l = the liquidus temperature above which no devitrification occurs

T_a = the lowest temperature of visible devitrification

T_m = the temperature at which maximum rate of crystal growth occurs

R_m = the maximum rate of crystal growth

From the practical point of view, it is of vital importance to know the liquidus temperature. Glasses are unfavorable for manufacturing and working purposes if their liquidus temperature falls within their working range. Thus, we have to know the liquidus temperature because below that, if glass is formed or reheated, unwanted devitrification may appear. If two or more glasses have the same liquidus temperature, for selecting a glass with the most favorable devitrification characteristics we must know the rate of crystal growth and the lowest temperature of visible devitrification.

Although the devitrification behavior of glasses in general has been studied by several investigators and many references concerning it may be found in the literature,[1] the two most important glasses used most frequently in vacuum techniques have received insufficient attention, i.e., the lime glass for manufacturing electric light bulbs and the lead glass for drawing tubes and rods.

Kalsing, Schmidt and Thomas,[2] investigating the problem of devitrification of technical glasses in general, established the rate of crystal growth of lime and lead glasses, in particular. The chemical composition of the glasses they investigated was as follows:

	Lime glass	Lead glass
Silica	70.3%	55.2%
Alumina	1.4	—
Lime	5.5	—
Magnesia	3.4	—
Lead oxide	—	32.2
Soda	16.4	4.3
Potash	1.0	8.3
Baryta	2.0	—

They have found that the liquidus temperature of lime glass was 930°C. and that of lead glass, 1050°C. The maximum rate of crystal growth of both glasses was 0.08μ/min.

The chemical composition of the glasses investigated by the author is similar to that of the lime glass given above and nearly the same as that for the above lead glass. The purpose of the work described in this paper was to examine the results obtained by Kalsing and co-workers and to investigate more thoroughly, in the case of both glasses, the tendency to devitrification and to establish their characteristics.

Description of the Experimental Method

To determine the tendency to devitrify, the author has used the method of forced crystallization.[3] The apparatus applied is shown in Fig. 2. The injunction of a Pt-PtRh thermocouple is placed into the middle heated zone of an electric furnace. The thermocouple is connected with an automatic temperature regulator and protected against the radiation of the furnace by an aluminum sheet. The intensity of current is adjusted with a rheostat to the required value. A red incandescent lamp indicates the current-free state of the regulator.

Each of the samples examined was about 10 mm in size. The samples rested on a ceramic body. They were placed into the hottest zone of the furnace where the temperature was held constant by the regulator. The temperature was raised in steps of 50°C. and the samples were heated for

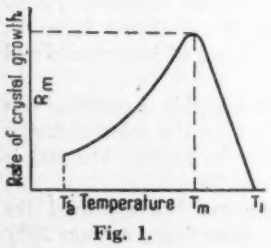


Fig. 1.

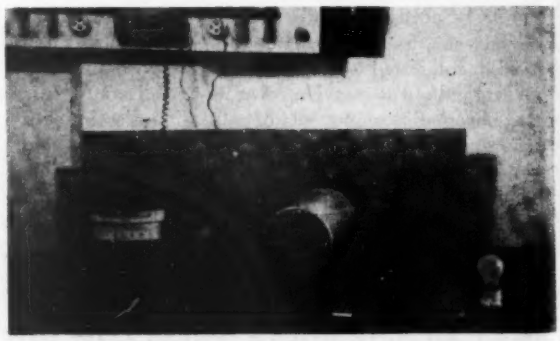


Fig. 2.

Reprinted from Acta Technica Academiae Scientiarum Hungaricae, Tomus VIII, 1954, Fasciculus 1-2, p. 67-78.

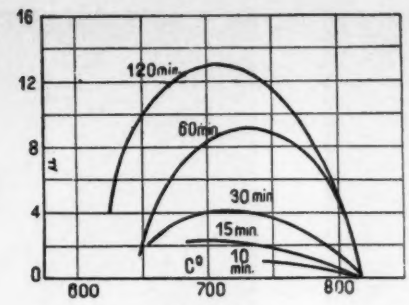


Fig. 3.

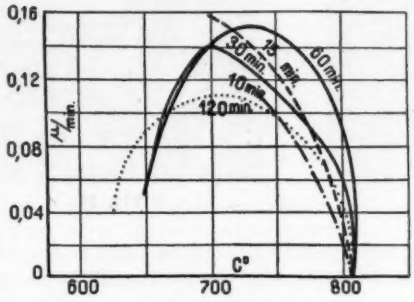


Fig. 4.

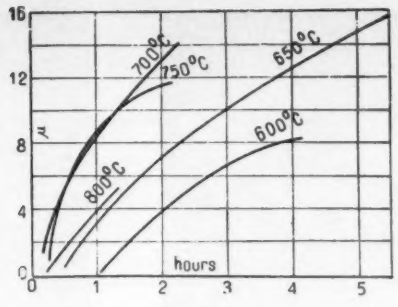


Fig. 5.

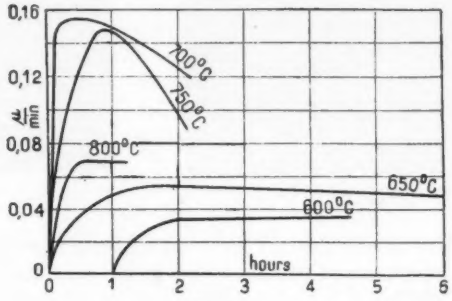


Fig. 6.

10, 15, 30, 60, 120, 240 and sometimes for 360 minutes. They were then rapidly cooled and observed with a microscope, and the crystal sizes were measured with 315-fold magnification.

Experimental Results

(*a*) *Lime glass for bulbs.* The results of the examinations, i.e., the crystal sizes obtained at the different temperatures and heating times, are summarized in Table I.

These data enable us to calculate the rate of crystal growth, provided that the beginning of the experiment is assumed to be identical with the time of devitrification. The values of the rate of crystal growth referred to different temperatures, and heating times are given in Table II.

Fig. 3 shows the connection between crystal size and temperature for different heating times. All the curves

TABLE I.

	Minutes							
	10	15	30	60	120	240	360	
600°	—	—	0.0	0.0	4.1	8.3	deformed	
650°	—	—	1.6	2.0	6.6	—	16.6	
700°	—	2.4	4.2	8.3	13.2	deformed	deformed	μ
750°	1.0	—	3.3	9.1	11.6	deformed	—	
800°	—	0.5	2.0	4.0	deformed	—	—	
850°	—	—	—	0.0	—	—	—	

TABLE II.

	Minutes							
	10	15	30	60	120	240	360	
600°	—	—	—	—	0.034	0.035	—	
650°	—	—	0.053	0.033	0.055	—	0.046	
700°	—	0.160	0.140	0.140	0.110	—	—	μ/min.
750°	0.100	—	0.110	0.150	0.100	—	—	
800°	—	0.033	0.070	0.070	—	—	—	

Fig. 7.

Fig. 8.

Fig. 9.

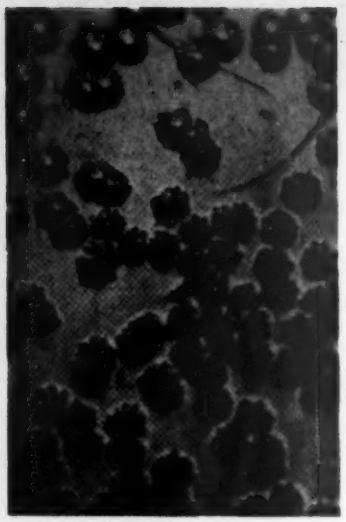


Fig. 10.

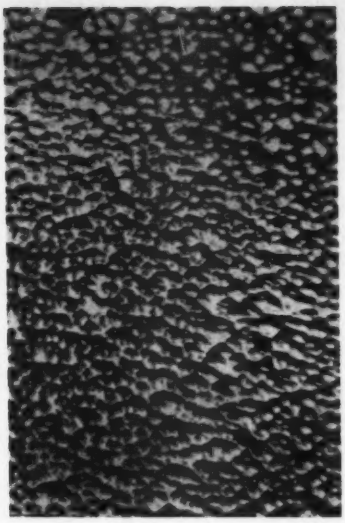


Fig. 11.

Fig. 12.

reach zero at one and the same maximum temperature. This temperature is 820°C. Above it no devitrification occurs and below it the crystalline and liquid phase are simultaneously present. Thus, this temperature is the liquidus temperature of the examined lime glass. The maximum crystal size appeared at different temperatures —partly at 700 and partly at 750°C.—if different heating times were employed.

Fig. 4 summarizes the relationships between rate of crystal growth and temperature for different heating times. These curves also afford proof of the liquidus temperature lying at 820°C. In Fig. 5, we can see the connection between crystal size and heating time at different temperatures. These curves show approximately the same trend.

Fig. 6 records the relationships between rate of crystal growth and heating time. As can be seen at 600, 650 and 800°C., the curves behave similarly and their maximum values are nearly constant. On the contrary, at 700°C., the rate of crystal growth increases rapidly for 15 minutes, decreasing after that time as is indicated by the soft slope of the curve. At 750°C., the μ/min. value increases for about 60 minutes and rapidly decreases afterward.

Changes in shape, size, denseness and deformation of crystals, with the lapse of time, are illustrated in Figs. 7-12. Comparison shows that the crystals from lime glass are uniform in shape.

(*b*) *Lead glass for tubes and rods.* The results obtained

(*Continued on page* 284)

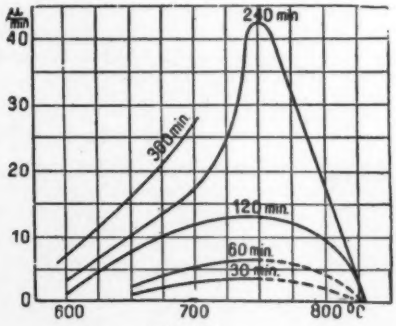


Fig. 13.

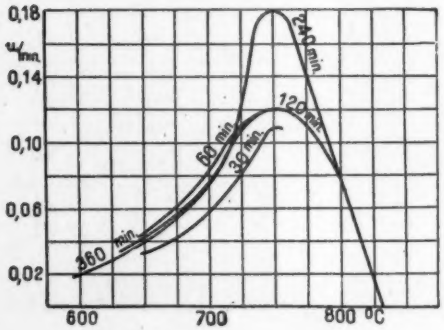


Fig. 14.

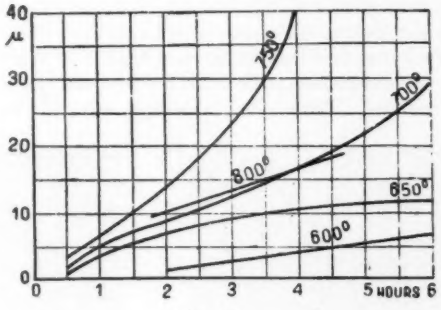


Fig. 15.

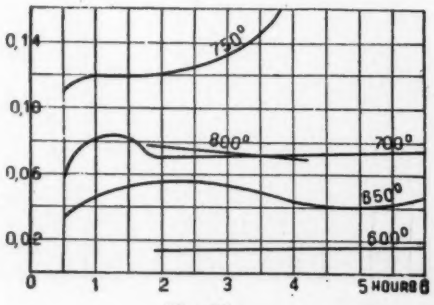


Fig. 16.

Inventions and Inventors

Feeding and Forming

Apparatus for Detecting Bowing in Rotating Cylinders or Rolls. Patent No. 2,691,851. Filed September 1, 1951. Issued October 19, 1954. Four sheets of drawings (none reproduced). Assigned to Pilkington Brothers Limited by Richard Davison and Hubert Cecil Wynne.

This invention is particularly advantageous for use in straightening the internally water-cooled casting cylinders or rolls used in continuous plate glass processes. In a co-pending patent application, Serial No. 244,832, filed September 1, 1951, there is described a means for detecting bowing in rotating cylinders and for straightening cylinders by controlling the bowing when detected. A sensing apparatus is described which is responsive to bowing in the cylindrical role and active over that part of the length of a cylinder where maximum bowing occurs. A stream of heat-transferring medium is delivered on to the sensed bowed portion of the cylinder when it is in the trajectory of the stream. A valve controlling the supply of heat transferring medium is actuated by an electric switch. The switch is operated by reason of the bowing of the cylinder or roll. The axial bending of the forming rolls is thus compensated and rectified with the result that less thickness variation is produced in the glass ribbon.

The patent contains 5 claims and the following references were cited: 1,954,027, Smith, Apr. 10, 1934 and 1,982,571, Clark, Nov. 27, 1934.

Glass Header Manufacturing Machine. Patent No. 2,961,246. Filed October 13, 1948. Issued October 12, 1954. Five sheets of drawings (none reproduced). Assigned to Sylvania Electric Products, Inc. by Henry W. Roeber.

The invention is related to the manufacture of glass envelopes, such as lamp bulbs, vacuum tubes and the like. A machine is adapted to receive a plurality of lengths of wire or terminal pins into the glass cup to form a header for a vacuum tube. The machine includes a work table, or carrier, in the form of a turret mounted to rotate about a vertical axis, and on which is a plurality of vertically extending spindles regularly spaced in a circle concentric with the turret and adjacent its outer peripheral edge. After the terminal pins are automatically dropped into the small apertures of the lower mold so as to extend upwardly, these spindles traverse a loading zone where glass wafers or cups having a central opening and smaller openings registering with those in the mold are placed on the molds with the pins extending. Thereafter, during the traverse of the spindles, the wafers or cups are subjected to flames from high heat burners for the purpose of fusing the metal terminals to the glass and for softening the glass so that when the spindles successively reach the passing stations, the glass is in condition for molding.

The patent contains 17 claims and 12 references were cited.

Process of and Apparatus for Drawing Glass into

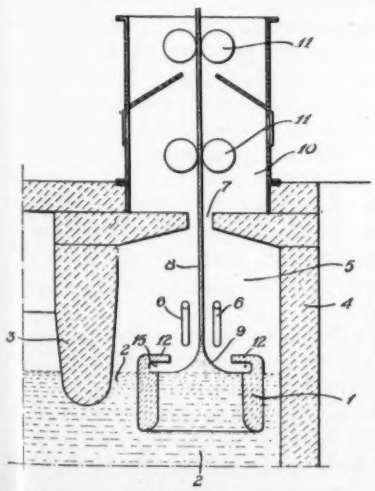


Fig. 1.

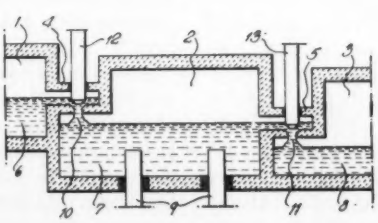


Fig. 2.

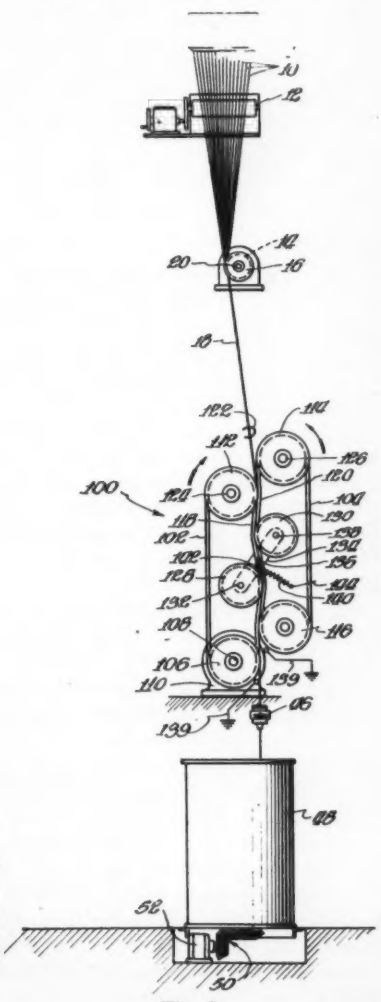


Fig. 3.

Sheet Form. Fig. 1. Patent No. 2,691,247. Filed August 4, 1949. Issued October 12, 1954. Four sheets of drawings. Assigned to Union Des Verreries Mecaniques Belges S. A. by Georges Henry and Edgard Brichard.

A process is shown for drawing of glass into sheet form, in a cooled chamber insulated from the atmosphere of the furnace, from a bath of molten glass bounded by a sheet-forming block or frame of refractory material. In Fig. 1, 1 designates the block or frame of refractory material situated in a part 2 of the molten glass which part is separated from the main mass of glass by a partially immersed wall 3 which, together with the outer wall 4 of the furnace, defines a chamber 5 cooled by pipes 6 or other elements through which a cooling fluid is passed. The chamber 5 communicates with the outside through a gap 7 of sufficient width to afford passage to the glass sheet 8 being drawn, which is initially formed in the bulb 9 and passes between the cooling pipes 6 and then into the drawing shaft 10, in which it is taken up by the drawing rollers 11. The longitudinal walls of the frame 1 are extended towards the bulb at 12 and reflect downwardly the radiation from the glass, so as to maintain between the walls and the bulb a sufficient temperature to prevent the formation of surface films on the glass. Electrical heat resisting elements 15 are optionally located beneath extensions 12. The desired temperature conditions are therefore obtained by protecting the surface of the glass against cooling due to radiation by means of these screens extending above and in proximity to the surface of the glass. These improvements in the drawing process are said to avoid a continuous rocking of the sheet.

The patent contains 17 claims and 24 references were cited.

Furnaces

Glass Tank Furnace and Method of Operating the Same. Fig. 2. Patent No. 2,691,689. Filed January 7, 1949. Issued October 12, 1954. One sheet of drawings. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain by Pierre Arbeit and Pierre La Burthe.

A novel glass tank furnace is shown in which means is provided for the prevention of movement of fined glass contained in the fining cell back to the melting compartment or of the already cooled glass contained in the conditioning compartment back to the fining cell. Back movements have a tendency to lower the quality of the glass.

Fig. 2 shows diagrammatically a partial longitudinal section of a continuous glass tank. It shows the end of the melting compartment 1, the fining cell 2 and a part of the conditioning compartment 3. Compartments 1 and 2 are connected by the conduit 4, compartments 2 and 3 are connected by the conduit 5, the cross-section of conduits 4 and 5 being small in respect to the cross-section of the cell. In the illustrated embodiment, the conduit 4 is placed at such a level that the level of the bath 6 in the melting compartment 1 is higher than the level of the bath 7 in the fining cell 2. The conduit 5 is placed in a similar manner, so that the level of the bath 7 in the fining cell 2 is above the level of the bath 8 in the conditioning compartment 3. The conduits 4 and 5 are provided in their bottom with orifices 10 and 11 having vertical axes. The fining cell 2 is electrically heated by means of horizontal electrodes or of vertical electrodes 9.

The patent contains 3 claims and 19 references were cited.

Glass Compositions

Glasses. Patent No. 2,691,599. Filed November 14, 1950. Issued October 12, 1954. One sheet of drawings (none reproduced). Assigned to The Ohio State University Research Foundation by Henry H. Blau.

New glasses which are especially useful for transmission of rays of relatively long wavelengths are revealed. These glasses have unusual optical properties, such as relatively high indexes of refraction, relatively low dispersion, and relatively high opacity to X-rays and other low wavelength radiations. They are formed principally of lead oxide, germania and lanthana or lead oxide, germania and alumina or lead oxide, germania and zirconia. The glasses contain major amounts of lead oxide or germania. A typical composition contains 77.0% lead oxide, 18.0% germania, 4% alumina and 1% zirconia. The fields of useful glasses are shown. The process of obtaining these glasses is important. Water must be removed from the glass. The process of eliminating water absorption bands is quite important and critical. The glass must be melted in a container free from silica and other harmful substances and the melt may be carried on in an atmosphere free from moisture. It is more practical however to melt without strict precautions as to moisture and to dry subsequently in a drying furnace using a continuous stream of dry gas (such as nitrogen or oxygen).

The patent contains 19 claims and the following reference was cited: 1,607,817, Dennis, Nov. 23, 1926.

Glass Wool and Fiber

Glass Fiber Drawing Mechanism With Means for Accentuating Strand Discharge. Fig. 3. Patent No. 2,690,628. Filed May 11, 1951. Issued October 5, 1954. Three sheets of drawings. Assigned to International Harvester Company by Joseph F. Courtney and Adelbert C. Radtke.

A novel apparatus is shown for attenuating glass fibers. In Fig. 3 the furnace 2 is provided with a die plate 4 through which a plurality of filaments 10 flow by gravity and are gathered by the workman and drawn in a fan arrangement downwardly over an applicator assembly against a side of sheave 14 through a V-groove 16. The filaments discharge from the gathering sheave in compacted form forming the strand 18. The strand 18 is then pulled downwardly and in a direction towards the sheave and then passed through the rotating drawing mechanism generally indicated 100, the mechanism including an endless drive belt 102 and an idler belt 104, disposed in a substantially vertical plane. A plurality of opposed belts, 118, 120, 104, etc., are employed and arranged to utilize the centrifugal force to grasp the strand 18 and move at their grasping areas along a curved or sinuous path.

The strands which discharge from the drawing means 110 prior to the attainment of desired drawing rate are discarded. When a strand is of correct dimension, it is passed through the blower 46 as in companion application for Glass Fiber Drawing Mechanism and Process, Serial No. 221,596, filed April 18, 1951. The strands are then deposited into canaster 48.

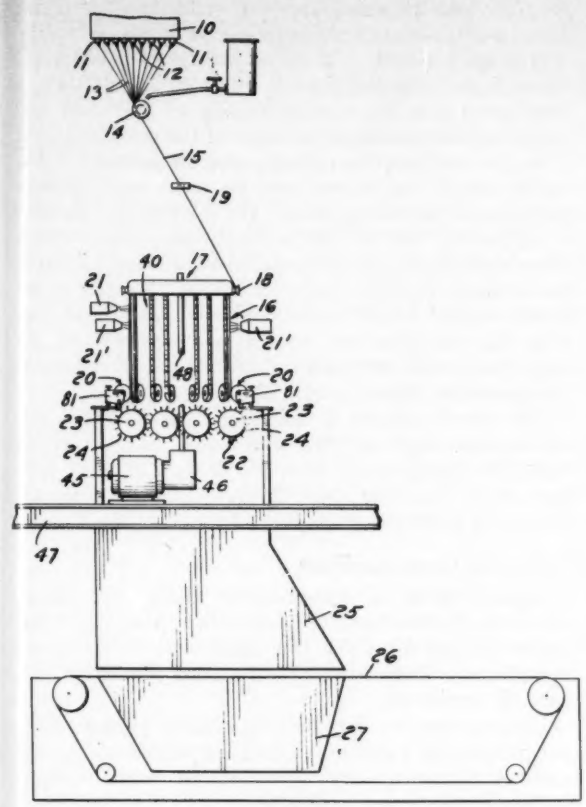


Fig. 4.

The patent contains 7 claims and 14 references were cited.

Method and Apparatus for Producing Fibers. Fig. 4. Patent No. 2,691,852. Filed December 29, 1949. Issued October 19, 1954. Six sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by Games Slayter and Warren W. Drummond.

The invention embraces a novel method and apparatus for producing, collecting and processing glass fibers in a manner suitable for use in manufacturing a wide variety of products. Fibers formed of molten glass or other fiber forming material are pulled over the gathering roll 14 to form a strand 15 which is conducted through the guide or eye 19 into contact with the guide roller 18 carried by the winder cap 17. With the motor 45 in operation, the shaft 48 is rotated at a comparatively high speed to rotate the winding cap 17 about the axis of the shaft 48 so that the strand 15 is conveyed in a circular path around the flexible conveyor elements or chains 40, the chains forming a collecting or accumulating device for the strand. If it is desired to apply a resin or binder to the strand on the conveyor, the resin may be sprayed on the strand by one or more applying nozzles or devices 21 as shown in Fig. 4. As the convolutions move along the conveyor 16, the resin or binder may be cured or set through the medium of the heat applying devices or burners 21′.

If it is desired to form sheets of the glass fiber strands, this may be accomplished by spraying the proper amount of suitable resin onto the convolutions of the strand by means of the applying devices 21 and the resin cured or set by the heating elements 21′. By utilizing one or a small number of cutters or strand severing devices 20 appropriately spaced about the periphery of the conveyor 16, the strand and resin may be severed so that the same may be discharged in the form of one or more sheets at the discharge zone of the conveyor 16. These sheets may then be flattened and rolled for subsequent use as plastic laminates or for subsequent molding into desired shapes.

The patent contains 14 claims and 15 references were cited.

Apparatus for Forming Mineral Wool. Fig. 5. Patent No. 2,689,373. Filed June 25, 1952. Issued September 21, 1954. Two sheets of drawings. Assigned to Charles Richardson Corporation by Charles D. Richardson.

An improved machine for converting molten slag into fibrous materials is shown in Fig. 5. The spinning head includes the cylindrical wall 35 and the end wall 36. The ends of the pipe shaft 25 and syphon pipe 29 project through the end wall 36 into the chamber. The cylindrical wall 35 of the spinning head is provided with an outwardly turned annular flange 40. Removably secured to the head by the bolts 42 is the spinning disc 41. Surrounding the spinner head is a fiberizing blast nozzle 44.

In the front wall of the ring 45 is formed the substantially continuous slot 49, preferably about .030 inch in width, and through this slot passes the fluid blast, steam or air, which intercepts the fine streams of slag from the spinning disc 41. However, in order to provide a travel path for the stream of molten slag as it spills from the cupola, approximately two inches of the slot is blocked, preferably by welding.

This block purposely breaks the continuity of the annular blast. As the fine streams of slag spin off of the disc 41 in all directions, part of the streams pass at an angle through this break in the curtain of fiberizing fluid. Therefore, to intercept these angularly travelling streams, and at the same time to avoid interference with the main stream which falls vertically onto the disc, there are provided a series of drilled holes 51. These several fluid jets intercept any streams which travel through the break in the curtain at an angle. Since the fine streams will be thrown tangentially from the disc 41 and since the disc is spun in a clockwise direction, the streams in the

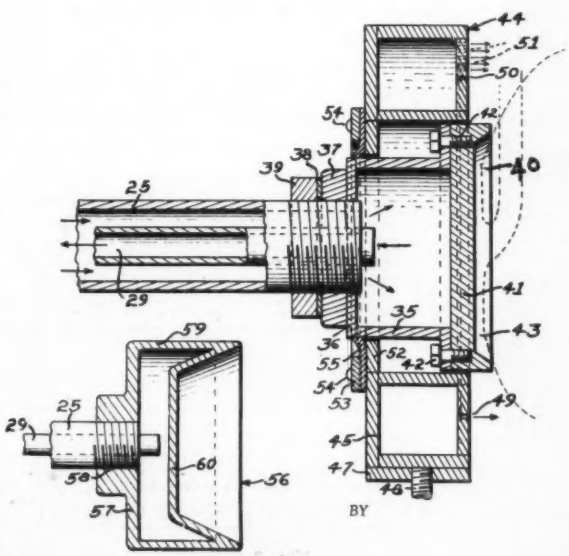


Fig. 5.

2" sector will be effectively intercepted by the fluid from the apertures, since these streams must travel transversely of the vertical line. However, the main supply stream drops vertically and finds its way without interception to the spinner head.

The patent contains one claim and the following references were cited: 65,339, Butcher, Jr., et al., June 4, 1867; 687,524, Fellner, Nov. 26, 1901; 1,051,844, Passow, Jan. 28, 1913; 1,834,687, Davis, Dec. 1, 1931; 2,318,244, McClure, May 4, 1943; 2,328,714, Drill, et al., Sept. 7, 1943; 2,470,569, Meighan, et al., May 17, 1949; and 2,587,710, Downey, Mar. 4, 1952.

Sheet and Plate Glass

Glass Bending Process. Fig. 6. Patent No. 2,691,854. Filed June 16, 1952. Issued October 19, 1954. Two sheets of drawings. Assigned to Ford Motor Company by Ormund E. Rugg.

This invention is concerned with the production of bent glass for curved windshields for automotive vehicles. The prime object of the invention was to reduce the breakage occurring during the bending process as the glass passes through a temperature range in which it is particularly brittle.

Two precut pieces of plate or sheet glass are laid one upon the other and the assembly is lowered upon the bending fixture which has an outline roughly similar to that of the glass to be bent. Rail 22 is usually built to enclose an area slightly smaller than the actual sheet of glass. Before the glass sheets are lowered into the bending fixture, the center section 12 is raised and hence stops 20 and 21 which are open sufficiently to receive the glass. The weight of center section 12, in particular, acts to apply a force to the glass parallel to its long axis, which force is applied through stops 20 and 21. It was determined that the unequal heating of the mold and the glass itself accounted for some of the glass breakage.

As an expedient for reducing this temperature differential, rail 22 was painted over its entire upper surface with conventional stove polish. The stove polish provides a surface on the rail 22, which behaves more like a theoretical blackbody and hence, absorbs more heat from its ambient. This thin layer of carbon also acts as an actual thermal barrier to the conductive transfer of heat from the rail 22 to the ambient and also serves as a high temperature lubricant to facilitate the movement of the glass with respect to rail 22.

The patent contains 2 claims and the following references were cited: 207,321, Wainwright, Aug. 20, 187[illegible]; 2,236,119, Craig, et al., Mar. 25, 1941; 2,377,849, Bickert, et al., June 12, 1945; 2,518,951, Smith, Aug. 15, 1950; and 2,549,535, Skooglund, Apr. 17, 1951.

Tube and Cane Machines

High-Temperature Thermometer Tube and Glass Therefor. Patent No. 2,691,855. Filed June 12, 195[illegible]. Issued October 19, 1954. One sheet of drawings (none reproduced). Assigned to Corning Glass Works by William H. Armistead.

Compositions for thermally opacifiable glasses which are particularly adaptable to be incorporated within the wall of high-temperature thermometer tubes without causing breakage are as follows:

	1	2	3	4	5	6	7	8	9	10	11	12	13
SiO_2	50.0	52.7	52	52	48	55	57	48	49	54	51	57	60
Al_2O_3	18.8	19.8	17	14	17	14	20	17	14	18	18	18	18
MgO	10.3	11.0	—	—	—	—	—	—	—	17	20	14	11
CaO	4.1	4.4	12	17	8	14	10	8	20	—	—	—	—
BaO	—	—	—	—	—	—	—	6	—	—	—	—	—
TiO_2	15.8	11.1	8	17	12	17	10	13	17	11	11	11	11
Li_2O	0.9	—	—	—	—	—	3	—	—	—	—	—	—
Na_2O	0.1	1.0	—	—	—	—	—	—	—	—	—	—	—
B_2O_3	—	—	11	—	15	—	—	8	—	—	—	—	—

The patent contains 10 claims and the following references were cited: 2,220,775, Navias, Nov. 5, 1940; 2,503,140, Stookey, Apr. 4, 1950; and 446,970, Great Britain, May 6, 1936.

Process of Producing a Light Diffusing Film on a Glass Surface. Patent No. 2,689,804. Filed February 7, 1952. Issued September 21, 1954. No drawings. Assigned to Philco Corporation by Meier Sadowsky.

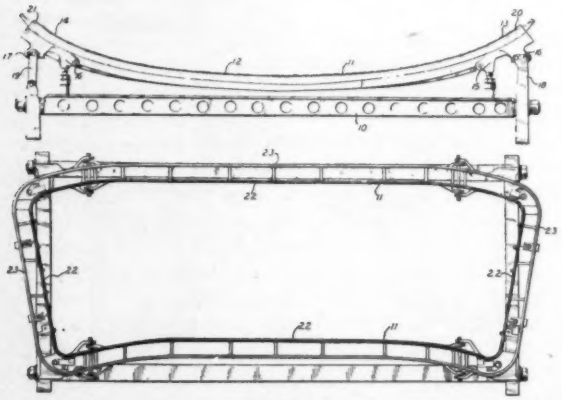


Fig. 6.

The invention relates to a method or process of treating the exposed or outer face of a direct view cathode ray tube of the general type used in television receivers to provide such face with a uniform diffusing surface which reduces specular reflection to a point where it is no longer annoying to the viewer.

The glass surface is thoroughly wetted with an excess of silicate solution of about 28 parts, by weight, of potassium silicate ($1K_2O:3.9SiO_2$ molar ratio) and about 72 parts, by weight, of water. When the solution has been applied, the excess is lightly wiped off with a soft absorptive material; for example, cheese cloth or absorbent cotton. This wiping off is done with light pressure and with repeated full strokes across the entire glass surface. In this manner, the solution is caused to spread in an even coat over every part of the glass surface. Following the wiping off step, the surface is lightly "rubbed" with a hard non-absorptive material; for example, steel wool or spun metal. The significant advantage of the "frost" producing process is that it produces, within a matter of seconds, a satisfactory light-diffusing frostlike coating which is hard and abrasion-resistant and which, when normally handled, will show no

smudges, fingerprints and similar markings.

The patent contains nine claims and the following references were cited: 2,356,553, Weissenberg, Aug. 22, 1944; 2,417,147, Wood, Mar. 11, 1947; and 2,428,357, Cohen, Oct. 7, 1947.

Miscellaneous Processes

Electric Incandescent Lamp. Patent No. 2,689,924. Filed January 25, 1951. Issued September 21, 1954. Two sheets of drawings (none reproduced). Assigned to Hartford National Bank and Trust Company, as trustee, by Wilhelm Honing, Herman B. Siebelink, and Simon Wijnberg.

An improved electric incandescent lamp of the so-called "sealed beam" type is shown. The pressed glass reflector section of the lamp envelope is provided with an integral external tubular projection, also of pressed glass, in which are sealed the supports or lead-in conductors for the filament or filaments, as well as the exhaust tube for the lamp. The tubular projection forms an enclosure which communicates with the interior of the envelope through an opening in the wall of the reflector section and the outer edge of the tubular projection is sealed to a glass stem carrying filament support wires which extend through the wall opening into the interior of the envelope. To minimize loss of reflected light from the reflector wall, the diameter of the wall opening is made as small as possible, preferably no greater than one-half or so the internal diameter of the tubular projection. Such a lamp base may be of the general form used on conventional type incandescent lamps employing blown glass bulbs, while the pressed glass base support may be of the general form employed in radio tubes.

The patent contains two claims and the following references were cited: 2,464,990, Plagge, Mar. 22, 1949 and 2,490,776, Braunsdorff, Dec. 13, 1949.

Nodulated Cellular Glass and Method of Forming. Patent No. 2,691,248. Filed December 19, 1950. Issued October 12, 1954. One sheet of drawings (none reproduced). Assigned to Pittsburgh Corning Corporation by Walter D. Ford.

This invention pertains to the manufacture of cellular glass bodies and has for its specific object the formation of small relatively spherical cellular glass bodies. No molds are required and annealing and subsequent processing are eliminated. The product formed is of closed cells and, therefore, is substantially impervious to moisture and vapors.

The glass used may be conventional lime-soda glass, known as window glass, or borosilicate glass containing considerable proportions (5 to 15%) of boric oxide, or other suitable glass. Preferably, the glass will contain suitable amounts (.08 to 2.5%) of an oxygen-giving agent, such as SO_3. If not, ferric oxide or antimony trioxide (in amounts of 0.1 to 8%) may be added to the pulverized glass-carbon mixture. The glass is pulverized, together with about 0.1 to 2% by weight of carbonaceous materials, to form a mixture, 95% of which will pass a screen of 200 mesh. The carbon may comprise lamp black, carbon black, coal or coke in amounts of 0.1 to 5% of the mixture. Where carbon black is used, about 0.1 to 0.2% by weight of the mixture is most suitable. It is recommended that care be taken to secure a uniform mixture of the glass and carbon so that the cellulation will also be uniform.

Pellets or nodules of the mixture are formed in a conventional pellet or briquetting machine. The pellets or nodules, after forming, are heated for sintering and cellulating. The nodules are gradually heated to a temperature of 1400° to 1500° F. to insure softening and cohering of the glass particles. They are then further heated to a temperature of 1600° to 1700° F. for cellulation. After cellulation is completed, the pellets are cooled to room temperature and are ready for use without annealing or further processing.

The patent contains 14 claims and 10 references were cited.

Formation of Reflecting Coatings. Patent No. 2,689,191. Filed December 10, 1948. Issued September 14, 1954. No sheets of drawings. Assigned to Radio Corporation of America by Leopold Pessel.

Light reflecting coatings on glass are made by forming a film of any one of a number of non-polar, non-saponifiable hydrocarbon resins on any suitable base material and then depositing a light-reflecting film of a metallic substance by chemical deposition on the resin film. By metallic substance is meant either a metal or metallic salt. It is necessary to form the resin film by dissolving the resinous material in a solution of a volatile solvent, applying the solution to the article which is to be coated and then evaporating the solvent.

An example of successful operation of the method is as follows: A glass plate was dipped into a solution comprising 100 g. of toluol and 5 g. of a cyclized rubber resin ("Piliolite"). The solvent was permitted to evaporate, thus forming a film of the resinous material on the glass. The coated plate was then immersed in a 2 per cent solution of stannous chloride for one minute, then rinsed thoroughly with water. The thus treated surface was then silvered, using the well known Rochelle salt formula.

The patent contains 7 claims and 13 references were cited.

OWENS-CORNING NAMES WEST COAST SALES MANAGER

The appointment of William H. Curtiss, Jr. as General Sales Manager of the Pacific Coast Division of Owens-Corning Fiberglas Corporation has been announced by L. R. Kessler, Vice President and Division General Manager.

Mr. Curtiss, who has been Sales Manager of textile products for the Division, now will also be responsible for sales of general products and sales of the company's West Coast contracting, supply and engineering subsidaries.

Mr. Curtiss joined Owens-Corning in 1946 and after service as a salesman in the company's Cleveland and Detroit branch sales offices, was assigned as administrative assistant to President Harold Boeschenstein. In 1949, Mr. Curtiss became Advertising and Merchandising Manager of the Fiberglas Textile Products Division in New York City, and two years later was named Textile Sales Manager for the company's Pacific Coast Division, a post he held until his recent appointment.

E. D. Herron, who has been Sales Manager of General Products for the Division, has resigned to become General Sales Manager of Commodore Industries, manufacturer of Fiberglas-reinforced plastic products.

C. I. YOUNG NAMED VICE PRESIDENT AND GENERAL MANAGER OF LACLEDE-CHRISTY

C. I. "Shay" Young has been named Vice President and General Manager of Laclede-Christy Division of H. K. Porter Company, Inc., according to an announcement by T. M. Evans, President. Mr. Young was previously Vice President in charge of Operations for all Laclede-Christy plants.

Before joining Laclede-Christy, Mr. Young had more than 30 years experience in the refractories industry. He was Assistant to the Vice President of Operations of Harbison-Walker Refractories Company and more recently was Executive Vice President in charge of Operations of Union Fire Brick Company.

GLASS SYMPOSIUM LECTURES ANNOUNCED

The lecture schedule for the Glass Symposium to be held at New York State College of Ceramics, Alfred University, on June 7 through 24, has been announced. Included in the course will be: *June 7,* "Glass as a Material and an Industry," S. R. Scholes, New York State College of Ceramics; "Glass: History and Evolution," Alexander Silverman, University of Pittsburgh; "Glass Compositions," W. C. Taylor, Corning Glass Works. *June 8,* "The Physical Chemistry of Glass," G. W. Morey, Geophysical Institution; "Glass to Metal Seals," C. D. Spencer, General Electric Company; "Glass as Engineering Material," E. B. Shand, Corning Glass Works, *June 9,* "The Color of Glass," W. A. Weyl, Pennsylvania State University; "The Refractive Index and Optical Properties of Glass," N. M. Brandt, Mellon Institute; "The Job of the Glass Technologist in Glass Industry," W. C. Decker, Corning Glass Works. *June 10,* "Glass for Electronic Uses," E. M. Guyer, Corning Glass Works; "The Viscosity and Annealing of Glass," H. R. Lillie, Corning Glass Works; "Durability," F. R. Bacon, Owens-Illinois Glass Company.

June 13, "Glass Sand," W. J. Woods, Jr., Pennsylvania Glass Sand Company; "Feldspar and Other Natural Minerals," H. B. DuBois, International Minerals & Chemical Corp.; "Soda and Other Industrial Chemicals," H. W. Harrington, Solvay Process Division, Allied Chemical and Dye Corp. *June 14,* "Chemical Analysis in Glass Manufacturing," R. L. Wilson, Thatcher Glass Mfg. Company; "Control by Physical Properties," R. K. Day, Libby-Owens-Ford Glass Company; "Storage, Mixing and Filling," F. V. Tooley, University of Illinois; "Fining and Decolorizing of Glass," R. R. Shively, Consultant. *June 15,* "Glass Melting and Furnace Design," R. S. Arrandale, Thatcher Glass Mfg. Company; "Fuels and Combustion Systems," Richard Reed, The North American Mfg. Company; "Temperature Control in Glass," J. R. Green, Minneapolis-Honeywell Regulator Company. *June 16,* "Fusion Cast Refractories," F. S. Thompson, Corhart Refractories Company; "Silica Refractories," S. M. Swain, North American Refractories Company; "Fireclay, Sillimanite and Zircon Refractories," E. A. Thomas, Chas. Taylor Sons Company. *June 17,* "Conditioning Glass: Forehearths and Feeders," A. K. Lyle, Hartford-Empire Company; "Lehrs and Kilns," H. C. Weller, Surface Combustion Corp.; "Decoration of Glass," H. V. Remington, B. F. Drakenfeld & Co., Inc.

June 20, "Defects in Glass: Stones, Bubbles and Cords," H. R. Swift, Libby-Owens-Ford Glass Company; "Laminated and Tempered Glass," L. A. Keim, Pittsburgh Plate Glass Company. *June 21,* "Window Glass," F. W. Mowrey, American Window Glass Company; "Rolled Sheet Glass," J. S. Herbert, Blue Ridge Glass Corp.; "Fiber Glass," Games Slayter, Owens-Corning Fiberglas Corp. *June 22,* "Containers," H. H. Holscher, Owens-Illinois Glass Company; "Crystal Glassware," A. E. Williams, Fostoria Glass Company; "Consumer Products," John Carter, Corning Glass Works. *June 23,* "Glass Blocks and Foam Glass," H. G. Jones, Pittsburgh Corning Corp.; "Silicones," R. R. McGregor, Mellon Institute; "Technical Glass," J. J. Moran, Owens-Illinois Glass Company. *June 24,* "Optical Glass," C. H. Hahner, National Bureau of Standards; "New Products," W. W. Shaver, Corning Glass Works; "Research Horizons," J. F. McMahon, New York State College of Ceramics.

OVERMYER SECOND ANNUAL SERVICE AWARDS

The Second Annual Services Awards Banquet for Overmyer Mould Company of Pennsylvania was held on April 4. Veteran employees of Overmyer's local plant were honored, with approximately 80 persons attending a dinner and formal program. Others joined the group later in the evening for a company dance.

The main speaker for the after-dinner program was Alexander E. Arnold, Director of Industrial Relations at the Robertshaw-Fulton Controls Company. Stressing veteran service as a foundation of the company's growth, Mr. Arnold emphasized the importance of personable leadership and steady cooperation between employees and management.

Top service award presented during the evening was to James Kindelan, Vice President of the company and Manager of the local plant, who has completed 25 years with the firm. Mr. Kindelan was presented with a watch by Lowell Roesner, President of Overmyer Mould Company. Twenty-five year lapel pins were presented by Charles S. Manrose, Secretary-Treasurer of Overmyer, to Jack Bates, James DeFloria, Gerald Duckworth, Henry Greenawalt, Alfred P. Smith and Robert Bauer.

Those earning 15-year awards, which were presented by Vice President Earl R. Flatter, were Robert Gesalman, Theodore Harbaugh, Robert Royal, George Throm and Walter Veshosky. Ten-year pins were given by C. M. Hawkins, Sales Manager, to John Krupey, James Philips, Edgar Smith, Michael Stabile, Donn Stouffer, Frank Petroy, Paul Harenchar, Sr. and Dorothy Testa.

• J. D. Thompson, The Homer Laughlin China Company, has accepted the chairmanship of the China & Glassware Division of the Committee of American Industry, it has been announced. A division of the National Fund for Medical Education, the CAI is spearheading a nationwide appeal to raise $10,000,000 for the country's 80 medical schools.

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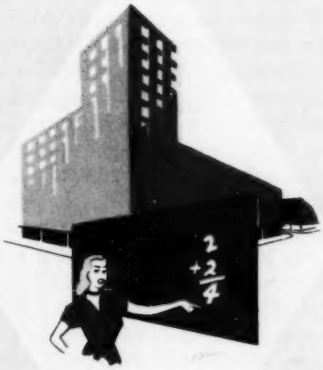

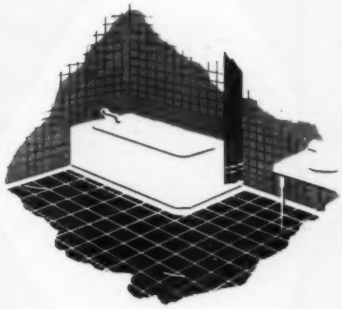

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BOOK REVIEW

Optical Glassworking

By F. Twyman, F.R.S.

This book is an abridged version of the second edition of the author's "Prism and Lens Making" and has been written by request as a textbook to meet the needs of those engaged in or studying optical glassworking.

Although the book has been considerably reduced in size for convenient reference on the work-bench, etc., no passages have been omitted which would detract from its value. Chapters include Historical, Single Surface Working, Tools and Materials, Production of Lenses in Quantity, Production of Spectacle Lenses, Microscope Lenses, The Production of Prisms in Quantity, Non-spherical Surfaces, Testing Optical Work, The Hilger Interferometers for Testing and Correcting Prisms and Lenses, Surface Treatments, Testing Optical Glass, Large Object Glasses and Mirrors, and Reference Books on Optics and Glassware.

Published by Hilger and Watts Limited, Hilger Division, 98 St. Pancras Way, Camden Road, London, N.W. 1, England; 275 pages; Price, 24s.

Named Assistant Manager of Plate Glass Sales is Samuel J. Prichard, Jr., who has served as special sales representative for southern United States since 1949. He has been associated with PPG since 1945, when he joined the firm's Roanoke, Virginia, distributing branch as a territorial salesman.

N. B. S. AWARDS

Dr. Irvine C. Gardner, National Bureau of Standards, has received the Gold Medal for exceptional service from the Department of Commerce. Secretary of Commerce Sinclair Weeks presented the award in recognition of Dr. Gardner's notable work, distinguished authorship and leadership among his colleagues in many fields of optics.

Dr. Gardner, Chief of the Optics and Metrology Division of N.B.S., has made many personal scientific contributions in the field of applied and geometric optics. His personal work has covered photogrammetry, photographic objectives, design and construction of optical instruments, military optical devices and the testing of optical instruments.

Also announced is the presentation to Dr. Ladislaus L. Marton, of the National Bureau of Standards, of the Gold Medal for exceptional service. This award was presented in recognition of his major contributions to science and technology in creating and developing the electron interferometer and the electron optical technique of mapping electrostatic and magnetic fields of extremely small dimensions.

Dr. Marton is Chief of the Electron Physics Section of the Atomic and Radiation Physics Division of the Bureau, and has received international recognition for his work in electron optics, particularly the development and perfection of the electron microscope.

• American Potash & Chemical Corporation has been presented an Award of Honor by the National Safety Council for the company's safety record set during 1954. The 1954 accident rate was the lowest in the company's history and was 89 per cent lower than the Safety Council's so-called "par accident rate."

Research Digest

The Infrared Transmission of Glass in Range Room Temperatures to 1400° C.

A knowledge of the transmission of glass at high temperatures in the region of the spectrum 0.3-4.5μ, in which it is ordinarily transparent, is of value in studying the fundamental changes which take place in the coloring agents in glass with changes in temperature. Other investigators have made measurements covering this region on various colored glasses at temperatures below the softening point. Measurements at higher temperatures on the commoner types of glass are required to obtain a better understanding of the problem of heat transfer in glass melting furnaces. It is on this phase of the problem that Grove and Jellyman deal with and have reported on in the February 1955 issue of the *Journal of the Society of Glass Technology*.

At the temperatures at which glass melting furnaces are operated, the peak of radiant energy is in the neighborhood of 2μ. It is therefore the transmission of glass in this region of the infrared, at temperatures up to the maximum reached by the glass in the tank, which influences the transfer of heat by radiation. Past attempts to explain the behavior of glasses in tank furnaces in terms of low temperature transmission factors in the visible regions have led to false conclusions. Kellett and Czerny have both investigated mathematically the problem of heat transfer by the mechanism of radiation, absorption and re-radiation, and have shown that this mechanism is the principal means by which heat reaches the bottom of the tank in the melting of ordinary glasses. From a knowledge of the infrared transmission of a glass at the temperatures concerned, a quantitative estimate may be made of its heat-transfer characteristics.

The layout of the complete apparatus used by the authors in this investigation is as follows: radiation from tungsten ribbon-filament lamp, after interruption by an 800 c/s chopper disc, was focused on the sample, supported in a platinum-wound tubular furnace, and was then brought to a second focus on the entrance slit of the monochromator. For use at temperatures above the softening point, a sample holder was made up in the form of a rectangular platinum-rhodium cell with fused silica windows one inch square and 2 mm thick, cemented in position, ¼-inch apart and strictly parallel. The hole in the furnace was rectangular in section and sufficiently wide to allow the beam of radiation to pass to one side of the sample. The furnace itself was capable of movement over a small distance in a direction at right angles to the beam. This movement was made automatic with a pause at at either end of the travel so that readings with the sample in and out of the beam could be taken and repeated with the minimum delay. This layout overcomes two of the main practical difficulties in measuring the transmission of glass at high temperatures. One is that the glass must be contained in such a way that radiation can pass through it, and the other is that a distinction must be made between the transmitted radiation and the radiation emitted by the glass itself.

The glasses on which measurements were reported comprised four experimental glasses containing iron, one containing nickel and a sample of "Calorex," a commercial bluish-green heat-absorbing glass of approximate percentage composition 67 SiO_2, 17 Na_2O, 12 CaO, 3 Al_2O_3 and 0.86 Fe_2O_3. The experimental glasses were melted in platinum crucibles and were of a base percentage composition 72 SiO_2, 15 Na_2O, 12 CaO and 1 Al_2O_3, calculated from the batch. The values for total iron content were obtained by analysis. These glasses were described as follows: No. 1, with no added coloring agent but containing 0.015% Fe_2O_3 as impurity, made under oxidizing conditions and referred to later as "low-iron glass"; No. 2, containing 0.16% Fe_2O_3, made under oxidizing conditions and referred to as "oxidized-iron glass"; No. 3, containing 0.16% Fe_2O_3, made under reducing conditions and referred to as "reduced-iron glass"; No. 4, containing 0.16% Fe_2O_3 and melted under strongly reducing conditions to give an amber glass; No. 5 containing 2% NiO.

The measurements obtained indicate that, in general, large changes in the infrared absorption of glasses take place with changes in temperature. Further work is required to study these changes in detail, but the following general conclusions were drawn from the measurements made.

(a) In a glass containing no added coloring agent, there is very little change in absorption over the range 0.6-2.6μ, apart from a small increase at either end of this range. No measurements have been made beyond 2.6μ, but in this region it is expected that changes in absorption with temperature take place similar to those in the amber and nickel glasses.

(b) All the iron-containing glasses absorb at room temperature throughout the infrared and have a maximum absorption at 1.1μ. This absorption, attributed to iron in the ferrous state, decreases in intensity as the conditions under which the glasses are made become more oxidizing, but it does not completely disappear even in the most highly oxidized glasses. The general level of absorption between 2.6 and 4μ is related to the presence of ferrous iron.

In general, as the temperature is increased to 1000°, the infrared absorption decreases continuously and then increases again at temperatures above 1000°C. This effect is more pronounced in the "reduced-iron" glass than in the "oxidized-iron" glass. At the same time, the absorption maximum becomes progressively less marked and moves to longer wavelengths until 600°C. is reached. Above 600°, the absorption at 0.6μ increases due to the short-wavelength absorption edge moving to longer wavelengths, this effect being most pronounced in the "oxidized-iron" glass.

In the case of the amber glass, the short-wavelength absorption edge extends almost to the infrared at room temperatures. As the temperature increases, the absorption at 0.6μ changes very little up to 600° and then decreases.

(*Continued on page* 280)

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during February 1955 was as follows: *Flat Glass:* A drop of .6 per cent is shown in the preliminary figure of 29,000 reported for February when compared with the previous month's adjusted 29,200. *Glass and Glassware, Pressed and Blown:* A preliminary 75,600 was reported in this category and represents a rise of 2 per cent over January's adjusted 74,100. *Glass Products Made of Purchased Glass:* An increase of .6 per cent is shown in the preliminary February figure of 14,600 when compared with January employment of 14,500.

Payrolls in the glass industry during February 1955 were as follows: *Flat Glass:* A drop of 4.5 per cent is shown in the preliminary $13,769,297 reported for February. This is a drop from January's adjusted $14,428,861. *Glass and Glassware, Pressed and Blown:* February payrolls were reported to be a preliminary $23,800,140. This is a rise of 2.5 per cent over the previous month's adjusted $23,218,741. *Glass Products Made of Purchased Glass:* The preliminary $3,827,633 reported for February indicates a drop of 1.1 per cent under January's adjusted $3,872,353.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

Narrow Neck Containers

	March 1955
Foods	1,038,000
Medicinal & Health Supplies	1,425,000
Chemicals, Household & Industrial	806,000
Beverages, Returnable	757,000
Beverages, Non-returnable	96,000
Beer, Returnable	184,000
Beer, Non-returnable	670,000
Liquors	837,000
Wines	420,000
Toiletries & Cosmetics	828,000
Sub-total (Narrow)	7,061,000

Wide Mouth Containers

Foods	*2,669,000
Dairy Products	201,000
Medicinal & Health Supplies	437,000
Chemicals, Household & Industrial	191,000
Toiletries & Cosmetics	204,000
Packers' Tumblers	167,000
Sub-total (Wide)	3,869,000
Total Domestic	10,930,000
Export Shipments	200,000
TOTAL SHIPMENTS	11,130,000

* This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production March 1955	Stocks March 1955
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	7,139,000	8,963,000
	Wide Mouth	*4,154,000	*5,284,000
Dairy Products		196,000	354,000
Beverages, Returnable		753,000	1,457,000
Beverages, Non-Returnable		114,000	195,000
Beer, Returnable		228,000	425,000
Beer, Non-returnable		694,000	856,000
Liquors		858,000	910,000
Wines		407,000	428,000
Packers' Tumblers		166,000	171,000
TOTAL		11,293,000	14,247,000

* This figure includes Fruit Jars and Jelly Glasses.

Glass container production, based on figures released by the Bureau of Census, increased 10.5 per cent during March 1955 to reach 11,293,000 gross. This is an increase over February's 10,211,000 gross. During March 1954, glass container production was 11,200,000 gross, or .8 per cent under March this year. At the end of the first quarter of 1955, production has reached a total of 31,837,000 gross. This is 3.4 per cent above the 30,766,000 gross produced at the end of the corresponding 1954 quarter.

Shipments of glass containers during March 1955 jumped 18.4 per cent to reach 11,130,000 gross. This is an increase over February shipments of 9,398,000 gross. During March 1954, shipments were 12,134,000 gross, or 8.2 per cent higher than for March this year. Total shipments of glass containers at the end of the first three months of 1955 are 30,173,000 gross. This is 2 per cent higher than the 29,554,000 gross shipped during the corresponding 1954 period.

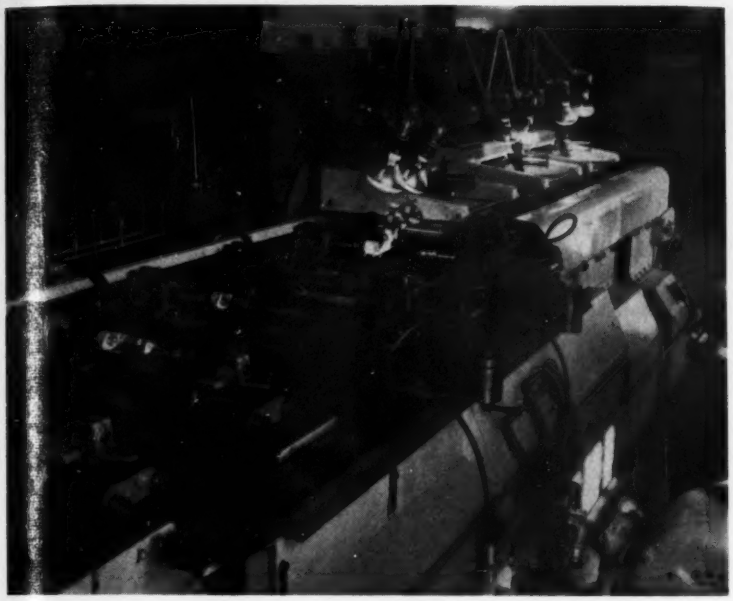
Stocks on hand at the end of March 1955 were 14,247,000 gross. This is 1.3 per cent higher than the 14,058,000 gross on hand at the end of February 1955 and 18.8 per cent higher than the 11,991,000 gross on hand at the end of March 1954.

Automatic tumbler production during February 1955 was 5,253,867 dozens. This is a drop of 4.3 per cent from January production, which was 5,492,341 dozens. During February 1954, production was 5,354,616 dozens. Shipments during February 1955 were 4,721,291 dozens, or 3.5 per cent under the previous month's 4,896,855 dozens. During February 1954, shipments were 5,063,867 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during February 1955 were 3,089,401 dozens. This is an increase of 12.3 per cent over January sales of 2,751,588 dozens. During February 1954, sales were 3,121,535 dozens. At the close of the 12-month period ending February 1955, manufacturers' sales reached a total of 37,889,203 dozens. This is 1.1 per cent below the 38,329,669 dozens sold during the corresponding 1954 period.

• Edward Mackasek has announced his retirement as Managing Director of the Porcelain Enamel Institute, completing eleven years of service as head of the staff operations. John C. Oliver will now head the Institute.

New Equipment and Supplies



FULLY AUTOMATIC DECORATING MACHINE

Rockware Glass Limited, Rockware Avenue, Greenford, Middlesex, England, has announced commercial production of a fully automatic machine for the decoration of glass containers with ceramic enamels. The features of this machine are that it will decorate three-color body labels and two-color neck labels at a speed of up to 50 per minute; it has a completely automatic operation throughout from an automatic feed-in to automatic take-out; it uses thermoplastic colors; it produces exact registration of one color with another and has a device for placing the label between the mold seams; it affords a great saving in labor.

The Rockware multi-label machine has been developed as a result of the invention of ceramic enamels dispersed in a wax medium instead of in oil bases making it possible to revolutionize previous processes. The new colors are wax-like solids at normal room temperatures, and become liquid when heated to about 150°F., the melting temperature, of course, depending on the wax used.

The machine consists essentially of three main inter-connected units: a loading unit, which receives bottles in single file, rotates them to a horizontal position and feeds them at the correct speed into the main printing unit; a main printing unit in which enamel designs are applied first on the body of bottles and subsequently on the shoulder or neck. The standard machine has three body-printing stations and two neck-printing stations so that bottles can be labeled in three colors on the body and two on the neck. Accurate registration between the colors is obtained and the location of the neck label, with respect to the body label, can be pre-determined for each job. In addition, the labels can be located automatically between the mold joins of the bottle; an off-loader, which receives labeled bottles in a horizontal position from the main printing machine, rotates them to the vertical position and delivers them to a conveyor.

The over-all width of the complete machine is 5 ft. 5 in. and its length is 27 ft. Its maximum height, including the radiant lamp holders, is 7 ft. It weighs approximatly 5½ tons. A compressed air supply at a pressure of 30-40 lbs. per sq. in. is required for opening the squeegees and the air cylinders connected with loading and off-loading bottles. The air consumption is about 30 cubic feet free air per minute.

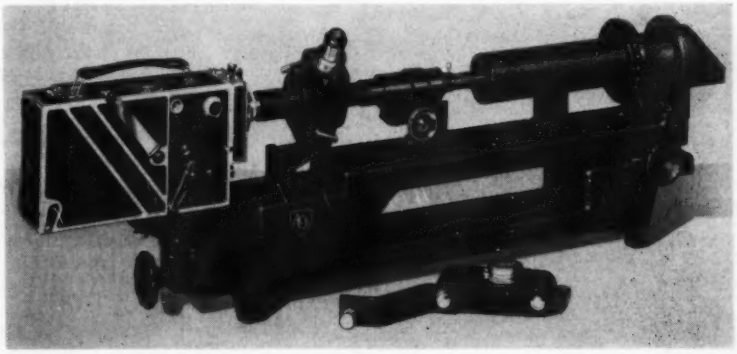
For setting up the machine at the beginning of a run, a trained mechanic is necessary. Subsequently, the machine requires only occasional supervision and attention, and does not occupy an operator full-time. The feeding of bottles to the loader requires one person, and at the unloading end it is necessary to provide one or more persons to remove the bottles from the conveyor, inspect the labels before firing them and to place them on a decorating lehr belt.

HIGH TEMPERATURE MICROSCOPE

American Optical Company, Instrument Division, Buffalo, New York, in conjunction with Henry N. Baumann, Jr., of the Research and Development Division of the Carborundum Company, has developed a new instrument for high temperature microscopy.

The new microscope provides a practical and efficient means for both visual examination and the photographic recording of specimens during their molten state in a microfurnace. Intended for refractories and ceramic research, it has been found most useful in the following representative studies: experiments to determine the corrosion of different refractories by different types of glass; melting points of crystalline material; softening and vitrification behavior of amorphous material, eutectics and ceramic compositions; inversion point determination, nature of certain types of crystallization and devitrification.

In principle, the image of the furnace specimen is transmitted through a specially designed relay lens which has a working distance of approximately 8 inches. It passes through an objective which is attached to a horizontally mounted microscope body. A rack and pinion focusing device is provided. A large graduated iris diaphragm, located adjacent to the relay lens, can be adjusted to vary the contrast of the specimen. A beam splitter in the optical path permits simultaneous use of both the camera and an eyepiece. It transmits 80% of the light to



the camera and reflects 20% to the visual eyepiece.

CUSHION CONVEYOR ROLLERS

Stilson Tool, Inc., 30233 Groesbeck Highway, Roseville, Michigan, offers Stilson all-neoprene rollers to save money by providing quiet, cushioned, dent-free, scratch-free rides for finished stampings, panels, glass, plexiglass, stainless steel and other materials.

Because they are molded, they have even density throughout insuring uniform wear, right down to the roller bearing core, which means longer life and less down-time. Parts and mountings are interchangeable. Installation is simple and fast.

Stilson engineers, in cooperation with leading automation engineers, have developed and perfected five rollers of varying design and density for use on die lifters, hydromatic welders and gravity roll conveyors, as well as idlers on belt conveyors and many other uses.

SCINTILLATION COUNTER TUBE

North American Philips Company, Inc., Research & Control Instruments Division, 750 South Fulton Avenue, Mount Vernon, New York, has announced a new Norelco scintillation counter tube for use with Norelco X-ray diffraction and spectrographic units.

The scintillation counter tube is 6 inches long, 1⅞ inches in diameter and weighs approximately 9 ounces. It has a resolving time of 1 microsecond, a threshold of 600 to 800 volts and a plateau of 75 volts minimum. Operating potential is 600 to 1200 volts, background is 45 counts per minute with 2 inches of lead shielding.

The sodium iodide crystal is mounted on the end of a photo-multiplier tube which detects light scintillations in the crystal produced by X-ray energy. The output is fed into a pre-amplifier and cathode follower which with the tubes are mounted on a small chassis.

CATALOGS RECEIVED

Overmyer Mould Company, Inc., Winchester, Indiana, in a new four-page folder, announces a new Overmyer service—the Lubracrome process.

The folder describes and illustrates the application of the process, giving the numerous advantages to be obtained from its use. Among these are that it lessens the need for lubrication, reduces the need for cleaning, doesn't chip or peel, offers a better bond and improves the quality of the ware.

Cambridge Wire Cloth Company, Cambridge, Maryland, has issued Bulletin No. 113 featuring Cambridge Industrial Wire Cloth.

The 4-page folder illustrates the various sizes of wire mesh and points up quality, delivery, service, design and manufacturing facilities.

Hooker Glass & Paint Mfg. Company, 659 W. Washington Blvd., Chicago, Illinois, has published a new 96-page maintenance guide and catalog.

Designed for contractors and maintenance men, the illustrated book features new developments in paints and finishing materials, as well as a comprehensive catalog of Hooker's paints, brushes, tools, glass and sundries.

Kaiser Aluminum & Chemical Sales, Inc., Chemicals Division, 1924 Broadway, Oakland 12, California, has prepared a new identification guide for Permanente Refractories.

The guide, a 4-page folder, shows colors that identify the various types of basic refractory brick produced by the company and lists name, number and other indentification of sacked ramming mixes, bonding mortars and furnace grains. In addition, the folder provides data on classification, application and special features of each refractory product and gives information on shipping points and sales offices of Kaiser Chemicals Division.

S. P. Kinney Engineers, Inc., 201 Second Avenue, P. O. Box 445, Carnegie, Pa., has issued a new 13-page brochure featuring its strainers.

The brochure contains photographs, descriptions, dimensions, capacities, installations and pertinent engineering information on the company's automatic, manual and twin basket strainers.

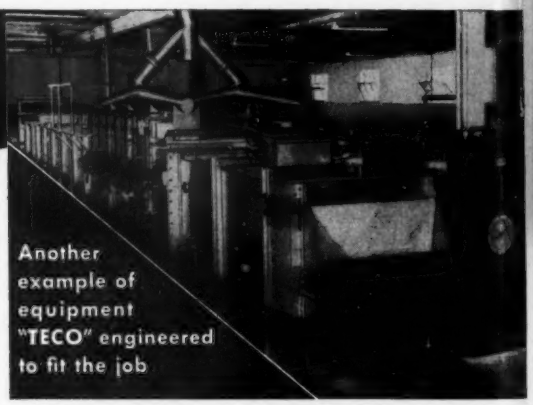
The NEW TECO COMBINATION

Bending-Decorating and Annealing Lehr

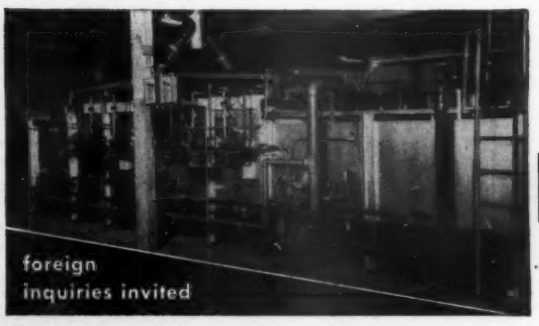
The TECO Combination Lehr bends, decorates and anneals sheet glass for lighting fixture parts or other similar uses.

This unique machine performs all three operations in one complete cycle at the impressive rate of 3000 pieces per hour.

High continuous production, controlled atmosphere, muffle fired for longer operating life and accurate automatic temperature control are some of the outstanding features of this remarkable lehr.



If you have a glass processing operation or series of operations which involve bending, decorating and annealing, we'll be pleased to discuss it with you in terms of what our combination lehr has to offer. If desirable we will design and build a special unit to meet your specific needs.



CONSULT "TECO"—your letter or phone call will be given our prompt attention

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DESIGNERS & BUILDERS OF GLASS MELTING FURNACES

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3001 SYLVANIA AVENUE, TOLEDO 13, OHIO

In the bottle washer, container labels are subjected to high temperatures and strong alkali solutions.

For excellent alkali resistance—use Du Pont Glass Colors

Washing with strong alkali and repeated sterilization can shorten the life of ordinary glass container labels, but not labels of Du Pont Glass Colors!

Durable Du Pont Colors withstand acids, alkali and continual sterilization. The smooth, even coats they produce are stable over a wide firing range . . . assure maximum coverage. Careful testing of each color before shipment assures you of uniformity and high quality.

Depend on Du Pont for a complete line of glass and ceramic colors: overglaze and underglaze, body, slip, glaze stains and squeegee oil. For complete information write E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Department, Wilmington 98, Delaware.

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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT GLASS COLORS

ATOMIC PACKAGED FOOD TESTS

Members of the Technical Operating Group got underway in late March with preparations for the testing of canned foods under atomic explosion conditions at the Nevada Test Site where the series of tests under sponsorship of the Federal Civil Defense Administration was underway.

The first job of the operating crew was the assembly of approximately 25,000 samples of about 60 different canned food items in various sized glass and tin containers. These were provided for the test by 153 members of the National Canners Association, and were assembled, pre-tested and coded in a Government Services Administration warehouse in Los Angeles, a job that occupied several weeks prior to their transfer to Nevada.

Shown above are Charles Collier, National Canners Association, and John Sharf, Glass Container Manufacturers Institute, tap testing glass jars to test their uniform initial vacuum and coding the samples. Among the preparations was the coding for the general tests to permit identification of results of the blast on samples at various distances from ground zero; under different exposure conditions, such as on the surface or buried, indoors or outdoors. Certain other samples were coded to enable later measure of extent of container damage, spoilage, fall-out effects, nutrient retentivity and other factors. Slat-racks were constructed to hold the nutritive samples. These were built to hold samples in single rows so that no container shielded another, enabling each container to receive the same exposure to the blast.

AMORY HOUGHTON, JR. ELECTED TO CORNING BOARD

Amory Houghton, Jr. was elected to the Board of Directors of Corning Glass Works at the company's annual meeting of stockholders held recently. He fills the vacancy on the Board which resulted from the amendment of the by-laws in March of this year increasing the number of directors to fourteen.

The new Director represents the fifth generation of the Houghton family to enter the management of the company founded in 1851 by his great-great-grandfather, and now headed by his father, Amory Houghton, Chairman of the Board.

Presently Manager of appliance parts sales in the company's Specialty Products Department, Mr. Houghton has been with the firm since his graduation from the School of Business Administration at Harvard.

WESTINGHOUSE EXPANDS GLASS PRODUCTION

An expansion and modernization program now underway at the Fairmont, West Virginia, glass works of the Lamp Division of the Westinghouse Electric Corporation is expected to cost upward of $250,000, according to a recent statement by F. M. Sloan, General Manager of the Lamp Division. When completed, the new facilities will make it possible for Westinghouse to manufacture several new types of glass and to expand production of types now being made at Fairmount.

Mr. Sloan said further that plans call for the completion of the glass works program by late July, but that a second expansion program will be undertaken later in the year to extend manufacturing lines at the Fairmont lamp plant.

Included in the program will be a 65-foot silo for the storage of raw materials and a modern conveyor system for elevating incoming raw materials into storage bins. All material handling equipment will be designed to minimize contamination and to provide favorable working conditions through dust control. A rearrangement of existing facilities will also improve storage for raw materials used to produce other types of glass now being made at Fairmont.

GLASS PLANT MERGER IN SOUTH AFRICA

Simultaneous announcements released by Consolidated Glass Works, Limited, and Union Glass, Limited, both located in South Africa, gave details of proposals to merge. The proposed merger is expected to result in substantial economies in the operation of both undertakings and place the bottle manufacturing in South Africa in a stronger position to meet competition from overseas glass factories.

It is planned that a new glass container factory will be built in the Cape Province. Both companies are substantial suppliers of glass containers to the wine, spirit, brewing and canning industries of the Cape.

GLASS QUALITY MANAGER NAMED AT BALL BROTHERS

General Manager J. E. Bellinger has announced the appointment of William E. Spencer, formerly of Allison Division of General Motors, as Manager of Quality Control for the Ball Brothers' Commercial Glass Division.

Mr. Spencer resigned an association of nearly 14 years with Allison, the last five years of which he supervised their quality control in transmissions operations. In his new position with Ball, he will be responsible for establishing new high levels of quality for glass containers and their application to Ball manufacturing.

COLUMBIA-SOUTHERN EXPANSION

Columbia-Southern Chemical Corporation has announced plans for the construction of a multi-million dollar titanium tetra-chloride producing plant at Natrium, West Virginia.

Located on the Ohio River on a site near the firm's large chlorine, caustic soda producing plant, construction of the new chemical producing unit will commence within a month. It is expected that the plant will be ready for partial production by April 1956.

OPERATING DATA

Furnace: Cross fired regenerative	
Type of glass: Soda lime flint	
Furnace depth: 22 inches	
Area of melting end, sq. ft.:	405
Total operating days:	1,175
Total tons melted:	89,031
Average tons per operating day:	75.8
Tons per sq. ft. of melt end:	219.8
Fuel: Natural gas	

LACLEDE-CHRISTY Cast 400 Block sets over 3½ year record!

- **Cast 400 helps set record campaign for leading glass producer —3 years, 7 months, 11 days**
- **219.8 tons per sq. ft. of melting end**
- **Average rate of 1 ton to each 5.34 sq. ft. of melting end hearth**

This soda lime glass campaign reflects superiority in glass-making —and also the superior qualities of Laclede-Christy Cast 400 Bottom Block. The campaign recently was concluded in a moderate sized tank with a 22 in. metal depth.

A campaign like this raises a pertinent question: Are *your* tank bottom blocks as long-lasting and economical as you'd like?

Cast 400 may be a money-saver for you, too. Just check with your nearby Laclede-Christy representative—or contact St. Louis.

LACLEDE-CHRISTY COMPANY

DIVISION OF H. K. PORTER COMPANY, INC.
2000 Hampton Avenue • St. Louis 10, Missouri
Mission 7-2400

Flame Photometry . . .

(*Continued from page* 256)

From Tables II and III it can be seen that there are many interfering ions present in a glass sample evaporated with perchloric and hydrofluoric acid. Sodium is easily compensated for in routine work where sodium oxide content variation is ±.2%. Aluminum is removed, but in removal ammonia is added. The effect of ammonia and perchlorate ion (added in the evaporation of the sample) is large. From these data on interference, it is apparent that small variations in the additions of reagents during sample preparation will cause unacceptable variation in the final results. A .3 ml variation in the amount of 1 N ammonia causes a variation of .2% in % CaO; a 5% variation in the perchlorate ion present is equivalent to a .2% variation in % CaO.

Erratic flame behavior can cause even more severe inaccuracy than interfering ions. With the Model B Spectrophotometer, regular cleaning of the burner reduces erratic flame character so that three readings should show a variation of less than ±.5% from the average. This is equivalent to ±.1% CaO. Inaccuracy due to burner instability should be reduced considerably by the use of the internal standard method[5] which can be used with some flame photometers.

Results

Samples of glass analyzed for CaO using the compensated standards method average +.2% higher than the results obtained gravimetrically on the same sample. The results also average + .2% over results of volumetric determinations made by a commercial glass analyst. One analysis was +.5% compared to the results of a commercial laboratory.

Duplicate runs on a glass sample using the oxalate precipitation procedure checked to better than ±.1% with gravimetric results by our laboratory and volumetric results by an outside analyst. For Bureau of Standards glass #80 and #128, CaO values of 4.6 and 4.8, respectively, were obtained. The Bureau of Standards lists #80 glass 4.65% CaO and #128 glass as 4.79% CaO. A system for separation of calcium by ion exchange[6] might be more convenient than the oxalate method, but such a procedure has not been tried by the author.

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6. Flame Photometric Determination of Calcium in Wet Process Phosphoric Acid. J. A. Brobson and W. D. Wilhide, Anal. Chem. 26 (6) 1060-61 (1954)

• An Academy Award "Oscar" has been presented to the Bausch & Lomb Optical Company for its scientific contributions to the motion picture industry. The motion picture industry award was made to the optical firm largely in recognition of its accomplishments in producing CinemaScope camera and projection lenses.

Research Digest . . .

(*Continued from page* 273)

At 1350°, its value is similar to that for the "reduced-iron" glass at high temperatures.

In the case of "Calorex," the changes in absorption with temperature are much greater than those in the other iron-containing glasses because of the relatively high iron content. In addition, the nature of the changes was complicated by the fact that the glass did not return to its original condition on cooling. In its final state, its absorption was much less than before heating, suggesting a decrease in the proportion of iron in the ferrous state.

For all the iron-containing glasses, the changes in absorption which take place with increasing temperature are of a form which suggests that the iron exists in a more highly oxidized state at high temperatures.

(c) In the case of the nickel glass, there is a general increase in absorption out of 2.6μ, with increasing temperature accompanied by changes in the shape of the absorption curve.

(d) Referring to the features of the absorption curves which are not dependent on coloring agents, there is some evidence that the absorption bands at 2.2 and 2.8μ, which are believed to be due to water in the glass, become more intense with an increase of temperature. At the same time, the broad absorption band at 3.5μ, which has been attributed to the carbonate ion, becomes less intense.

In the mathematical treatment of the problem of heat transfer in hot glass, it has been shown that absorption and re-radiation of energy cause a transfer of heat that can be regarded, away from the complications of boundary conditions, as equivalent to a "radiation conductivity."

From the results obtained, the average value of the absorption coefficient, in the region of 2μ, at 1200°C. for each glass, were estimated. Using this data, values for the "radiation conductivity" were calculated. The differences in "radiation conductivity" for the iron-containing glasses, due to different iron contents and states of oxidation, cover a range of 15-1. This is in accord with the observed differences in temperature gradients and bottom temperatures in tank-melted, commercial glasses of similar compositions.

LEEDS & NORTHRUP APPOINTMENT

Alfred E. Tarr, formerly Manager of the Sales Engineering Division of Leeds & Northrup Company, has been named Assistant to the President, it has been announced by I. Melville Stein, President.

Mr. Tarr joined the instrument firm in 1919, taking production and field training in the sales department. In 1931, he went to Chicago as District Manager of the Industrial Division. Upon his return to the home office in 1945, he became Sales Manager of the Sales Engineering Division in 1947.

• The Annual Spring Meeting of the Industrial Heating Equipment Association will be held at The Homestead, Hot Springs, Virginia, on May 15-18, it has been announced. Horace Drever, President of the Drever Company and President of the Association, will preside.

GAS AND OIL . . . FROM BRICK When you say: "Fill 'er up", you're putting brick to work. Refractory brick. For once crude oil is pumped from the well, every process in making petroleum products depends on heat that only refractory lined furnaces can handle.

Practically everything you buy or use, everything that's made or moved, is dependent on refractories. The steel in your car, the glass in your windshield, the rubber in your tires, and the "blacktop" of your drive.

When you consider the enormous variety of industry, and the infinity of processes, you get some inkling of the tremendous technology and scientific reservoir that General Refractories draws on to produce refractories of highest efficiency and utility for specialized needs.

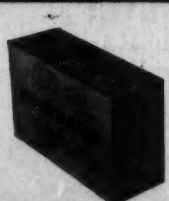
Company-owned sources half a world away pour in materials, all subject to the most exacting analyses and tests in the world's finest refractories laboratory, where new and finer products are constantly evolving.

With 66 mines and manufacturing plants, strategically located sales offices and warehouses, Grefco truly provides a complete refractories service.

GENERAL REFRACTORIES COMPANY
PHILADELPHIA 2

A COMPLETE REFRACTORY SERVICE

RITEX—Unburned basic brick—in magnesite, magnesite-chrome, and chrome-magnesite. More resistant to spalling. Lower porosity, lower thermal conductivity—high hot strength.



GREFCO SILICA BRICK are available at convenient locations from California to Pennsylvania. Glass men know there is no finer product. No more dependable supply.

OLIVE HILL—An exceptionally strong and dense fireclay brick—true to size and shape.

GENERAL REFRACTORIES

Meeting Reports . . .
(*Continued from page* 261)

Hardy-Rand-Ritter pseudo-isochromatic plates, which are now available from the American Optical Company, as a suitable screening and diagnostic test for color blindness.

Color of Transparent Materials: This committee has been revised and reoriented from an older committee studying single number color tolerances. It is at a terminal point and expects to go ahead in the next year.

Color Terms: This committee has been working on a comprehensive compilation of color names, together with their color notations. This work is along to the galley-proof stage and will be available to any interested persons during the coming year. It will be available from Government Printing Office at a cost of about $2.50. It will contain around 13,000 names of colors.

Colorimetry of Fluorescing Materials: This committee has concluded that for fluorescing materials the color temperature of the illuminant is more important than the amount of U.V. therein; they expect to recommend illuminant C.

Near White Surfaces: This problem, proposed by the American Ceramic Society's delegation and in which they reviewed the suitable methods of measurement, has been brought to a conclusion. The balance of their original problem is being done by a committee of the National Electrical Manufacturers Association. It is expected that this will result in specifications for appliance finishes.

Color Education: This is a new committee attempting to bring out the basic concepts which are necessary for a good education in color.

The reports of the delegates are interesting to hear but difficult to report since they come from such diversified fields. The American Ceramic Society delegation's report included the symposium on color included in the Spring Meeting in Cincinnati. The Industrial Designers' Institute called attention to the increasing amount of color being used on kitchen appliances. The Illuminating Engineering Society has been studying illumination of stores from the standpoint of the color used in packaging.

In the afternoon, there were four prepared papers which proved to be very interesting.

"How We See Color" by Dr. Robert W. Burnhan discussed some of the psychology of color perception illustrating the points constancy, adaptation, contrast effect, shape and color, and mode of appearance.

"Color Timing in Merchandising" by Mrs. Helen D. Taylor described the attributes of a colorist as one who has many aptitudes and is curious and a bit sensitive. She then went on to describe how colors come into our lives, changing seasonally during the time of their prominence and how the emotional conditions of the people affect the periods of popularity of colors. She then traced the history of certain colors. It struck this reporter that the ceramics industry could possibly use the services of the color consultants in order to be ready with the proper colors at the time they are most popular. This would be particularly true of some glass business and the tableware people since these items can be changed in the average family more easily. It would also be true in appliances and sanitary ware provided the colors were selected for longer periods of usefulness.

Richard Kelly, in "Control of Moods and Atmosphere," pointed out that in much indoor decoration, where we are using more glass in building construction, we are tending toward cooler colors which recede into the backgrounds.

"Color at Work," by Prof. Edward Carswell of the University of Toronto, gave some very interesting examples of the use of color in public buildings and commercial establishments. To illustrate the advantages of color, he told of putting out some disposable metal cooking dishes printed in color. The dishes normally sell for around five cents, but the color increased the cost by about one cent. The public could not be supplied with enough at 15 cents.

The evening program included a lecture, entitled "Creative Directions in Color Photography," by Ralph M. Evans. In this Mr. Evans, in his usual style and with his usual number of illustrative slides, showed how artists from various cultures in various times have used tricks or devices to portray their ideas. (The technique of distance has not always been foreshortening.) The common criticism of photography as an art form is that it is mechanical and not subjective. Mr. Evans brought out that the photographic film does not record just what the eye sees, and that the photographer can use the film, as a painter uses canvas or the sculptor uses clay, to create an impression as he wants it to be created. Some of his examples included such things as the blue shadows which are clearly visible in color photographs, but which most of us fail to see when we look at the original.

ACTIVITIES AT CORNING

Limited shipments of 22-inch rectangular glass bulbs for color television tubes are now being made by Corning Glass Works, according to J. S. Muller, Sales Manager of the Electronic Sales Department.

Mr. Muller stated that the 22-inch bulb is the largest now in production and that Corning expects it to become the standard of the color television industry. The new tube is approximately the same length and height as the 19-inch round bulb and is designed to fit into the same size cabinet. It is designed for a shadow mask tube and is constructed so the mask can be mounted by either of the two methods now in use—the flat land or the pin method. The bulb is adaptable to either the three-gun or single-gun system.

The availability of precut, ready-to-use glass tubing for hermetically-sealed, all-glass diodes has also been announced by Corning. Previously available in only three and four foot lengths which are cut by the diode manufacturer, the glass tubing is now being sold by Corning precut for both diode cases and diode sealing beads. The company also said that bead and case diameters are being produced to a tolerance of $\pm$ 0.002 inches. Length tolerances are $\pm$ 0.004 inches on the bead and $\pm$ 0.005 inches on the case.

"Glass and You," Corning Glass Works' 16-mm color film has been given a Golden Reel Award by the Film Council of America. The award was presented at the 1955 Golden Reel Film Festival. "Glass and You" was selected as the best film in the Industrial Processes category.

HAZEL-ATLAS USES TRUCK TO DEMONSTRATE RESEARCH

The Hazel-Atlas Glass Company, after extensive research in the matter of handling materials by mechanical methods, has developed a program for demonstrating the results of its research.

The company has acquired and equipped a transport truck which will carry a Pul-Pac type power lift truck, a quantity of disposable paper pallets, dockboards and supplementary equipment, together with trained personnel, to various points in the United States and there conduct on-the-job demonstrations showing the adaptability of that type of equipment to various handling problems and under actual operating conditions. Several demonstrations to joint groups have already been conducted.

KOPP GLASS APPOINTMENTS

Kopp Glass, Inc. has announced the appointment of Willard A. Provost as Assistant Sales Manager, and of John E. Bright as Manager of the New York Sales Office.

Mr. Provost, who previously was Eastern Sales Manager, will maintain headquarters at the company's Swissvale, Pa., plant. He has been associated with Kopp Glass in various sales capacities since 1940.

Mr. Bright has been a member of the firm's sales department in Swissvale. His headquarters in the New York area will be in East Orange, N. J.

WEST END CHEMICAL EXPANSION

West End Chemical Company will start producing salt cake and anhydrous sodium sulphate by approximately mid-summer, 1955. It will be extracted from the natural brine deposits at Searles Lake, California, and processed by special equipment now under construction.

The evaporator is a vital part of the new processing technique. Designed and patented by H. D. Hellmers, Vice President, and J. V. Wiseman, Research Director, the evaporator is the first of the major equipment now completed and in place. Initial production will be at the rate of 50,000 tons annually. Being not simply a by-product but a chemical produced chemically in a chemical plant, West End sulphate will be of very high quality.

• Loran S. O'Bannon has been named Technical Advisor at Battelle Institute. As a member of the staff of the Office of the Director, he will provide liaison between the Institute and its clients in industry.

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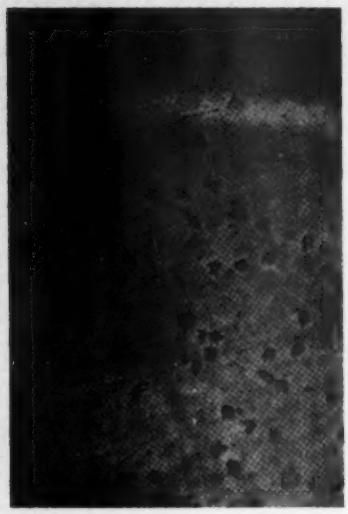

Fig. 17.

Fig. 18.

Fig. 19.

from measuring the devitrification characteristics of lead glass of the aforementioned chemical composition are listed in Table III, giving the sizes of crystals at different temperatures and heating times. The rate of crystal growth at different temperatures and for different heating times is contained in Table IV.

TABLE III.

	Minutes					
	30	60	120	240	360	
600°	—	0.0	1.7	3.3	6.7	
650°	1.0	2.5	6.7	10.0	16.7	
700°	1.7	5.0	8.3	16.7	26.8	μ
750°	3.3	6.7	13.4	43.0	—	
800°	—	—	10.0	16.7	—	

Fig. 13 shows the relationships between crystal size and temperature for different heating times. The curves fall to zero at 830°C., indicating this to be the liquidus temperature of the lead glass. The crystals develop their maximum size at 750°C. It is 2.5 times greater than that of lime glass.

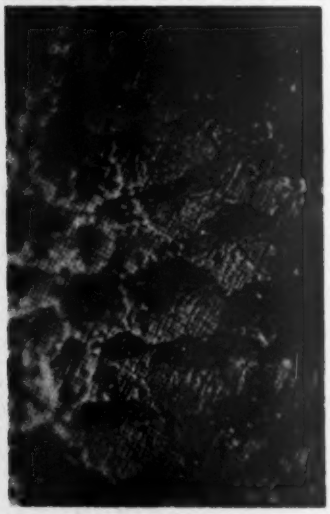

Fig. 20.

Fig. 14 gives the relationships between rate of crystal growth and temperature for different heating times. Fig. 15 shows the relationships between crystal size and heating time for different temperatures.

Fig. 16 demonstrates the relationships between rate of crystal growth and heating time. All the curves indicate that the rate of growth rapidly increases at 750°C. and is nearly constant at the other temperatures.

TABLE IV.

	Minutes					
	30	60	120	240	360	
600°	—	—	0.014	0.014	0.018	
650°	0.033	0.042	0.056	0.042	0.047	
700°	0.057	0.083	0.069	0.070	0.075	μ/min.
750°	0.110	0.120	0.120	0.180	—	
800°	—	—	0.077	0.070	—	

Changes in shape, size, denseness and deformation of crystals, with time, are shown in Fig. 17-20. On comparing them, it can be seen that, contrary to those of lime glass, the crystals are dissimilar and rather varied in shape.

Conclusions

(1) On checking up on the devitrification characteristics established by Kalsing and co-workers, it has been found that the liquidus temperatures of lime and lead glasses used in vacuum techniques are lower and the rates of crystal growth higher than published by them.

(2) Table V summarizes the devitrification characteristics of lime and lead glasses according to the author's experimental results.

TABLE V.

Devitrification characteristics	Lime	Lead
Liquidus temperature °C.	820	830
Lowest temperature of visible devitrification °C.	600	600
Maximum rate of crystal growth μ/min.	0.16	0.18
Temperature at which maximum rate of crystal growth occurs °C.	700	700
Shortest time in which visible microscopic crystals appear, min.	10	30
The greatest crystal size, μ	16.6	43.0

Summary

From the point of view of forming when molten and of reheating finished glass articles, the devitrification behavior of glass is a property of great importance. The devitrification tendency is determined by four characteristics: by the liquidus temperature, above which no crystallization occurs; by the rate of crystal growth, which is

the relation between crystal size and heating time; by the temperature of the maximum rate of crystal growth; and by the lowest temperature at which microscopic crystals appear. The article studies the devitrification behavior of two glasses frequently used in vacuum techniques, i.e., that of lime glass used for manufacturing incandescent bulbs, and that of lead glass employed in drawing tubings and rods. According to the results of artificial crystallization, the liquidus temperature of the lime and lead glasses is nearly the same and is about 825-830°C. It has been established that lime glass has less properties favoring the development of crystals of maximum size. The shape of the crystals, their relative size and the deformation of the glass surface due to advanced devitrification are illustrated in 10 photomicrographs.

Acknowledgment

The author is very much indebted to his colleague, Mr. Lorand Sass, for taking the photomicrographs for this paper, and also to the Director of the Industrial Research Institute for Telecommunication for permitting this publication.

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1. Kitaigorodski, I. I. (Glass Technology) Moscow, 1951; Morey, G. Properties of Glass, New York, 1938. (This book contains many references.)
2. Glastechn. Ber. Vol. 21, No. 3, 1943, Page 66.
3. Kitaigorodski, I. I. (Glass and Glass Melting) Moscow, 1950.

BAUSCH & LOMB ELECTS OFFICERS

The election of William W. McQuilkin as a Vice President of Bausch & Lomb Optical Company has been announced following the recent annual meetings of stockholders and of the Board of Directors.

The election of Joseph W. Taylor as Assistant Treasurer was also announced. Mr. Taylor was also re-elected Secretary, and all other officers were re-elected.

Mr. McQuilkin, who joined the optical firm in 1938 as head of its legal department, will continue to serve as Treasurer and a Director. He became Secretary in 1943, Assistant Treasurer in 1947 and Treasurer in 1949.

A graduate of Yale University and Harvard Law School, Mr. Taylor joined Bausch & Lomb's legal staff in 1946 and two years later became Director of Industrial Relations. He was elected Assistant Secretary in 1947 and Secretary in 1951.

CONSOLIDATED FELDSPAR ANNOUNCES STAFF CHANGES

H. B. DuBois has been named to a new position in the Consolidated Feldspar Department of International Minerals & Chemical Corporation's Industrial Minerals Division, and W. K. Burriss has been newly appointed to that department, according to an announcement by Norman J. Dunbeck, Vice President in charge of that Division.

Mr. Dubois, formerly Sales Manager for the Consolidated Feldspar Department, has been made Assistant Manager. Among his new duties will be production-sales liaison and public relations services.

Mr. Burriss joined Consolidated as Sales Manager. He was formerly associated with Industrial Publications. Both men will make their headquarters at Erwin, Tennessee.

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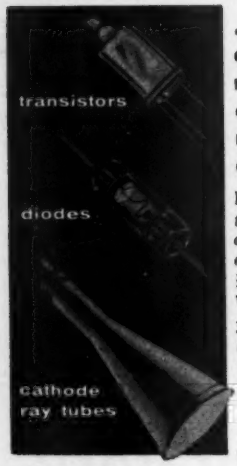

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AMERICAN NEPHELINE OPENS NEW RAILROAD SPUR

The official opening recently took place of a new 17-mile C.P.R. spur line from Havelock, Ontario, to the plant of American Nepheline Limited at Nephton, where "Lakefield" nepheline syenite is mined and milled, bringing this important natural resource closer to Canadian and world industry.

Provision of railway transportation direct from the ore deposits and mill to the railhead is an important milestone in the company's development. Previously, the ore had to be shipped by barges down the Kawartha system. Highway trucks have been used extensively but now, for the first time, there is available the means of rapid, regular bulk shipments to keep up with the growing demand for the product.

THATCHER APPOINTMENTS AND SALES REALIGNMENT

Samuel E. O'Connel has been appointed Manager of a newly-created Merchandising Department of Thatcher Glass Manufacturing Company, Inc. The announcement was made by William J. Green, Executive Vice President and General Sales Manager. Also named as Assistant Merchandising Manager is John T. Pollock, previously head of Thatcher's Scheduling Department.

The new department is designed to provide a complete merchandising and sales promotion service for all Thatcher Glass Container and McKee Division customers. The department will also be responsible for all special merchandising and premium sales programs.

Also announced is the division of two glass container groups in the sales organization. The moves have been made to provide more complete service.

The General Line Division, which handles sales of food and related containers, will be headed by George Dusterdieck, who formerly managed Thatcher's Midwest Container Sales Office. William R. Rifenburgh, who previously headed the General Line Division, is now Sales Manager of the Liquor and Wine Division.

The Beer and Beverage Division, which had been headed by Lyle F. Harder, has been separated into two groups. Mr. Harder will now manage the Carbonated Beverage Division, while Walter S. Bazzett has been appointed Sales Manager of the Beer Division. Mr. Bazzett was assistant to the General Sales Manager.

NEW FIBERGLAS SCREENING

The Lifetime Fiberglas Screening Company, Inc., Canton, Mass., has announced a new and different screening woven of Fiberglas, which is supplied to the company by Owens-Corning Fiberglas Corporation, which does not manufacture screening.

Introduced in a "do it yourself" package, the Fiberglas has a core of hundreds of glass filaments 15 times finer than a human hair and with tensile strength of over 250,000 pounds per square inch. Fused around these filaments is an inseparable coating of sinewy vinyl. The coated Fiberglas is rust proof, and cannot stain side walls or sills, will not mildew, resists most acids and oils and is unaffected by salt air, making it suitable for coastal regions. The new Fiberglas screening is easy to handle and install. It is soft and flexible, yet does not crease. The weave is fused to prevent fraying of cut edges.

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INTERNATIONAL MINERALS TO BUILD NEPHELINE SYENITE PLANT

International Minerals and Chemical Corporation will start construction immediately on a nepheline syenite plant to cost $1,500,000 at Blue Mountain near Havelock, Ontario, according to Louis Ware, President.

The corporation controls at that point a deposit of about 30,000,000 tons of superior quality nepheline syenite, a high-alumina, high-alkali mineral, which is an important raw material for the glass and ceramic industries. The plant will be the most modern and efficient in the industry and is expected to be completed in late 1955.

• Societe Rhone-Poulenc has started commercial production of a complete line of silicones in its recently-completed plant at St. Fons, near Lyon, France, it has been announced.

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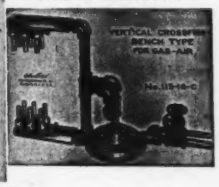

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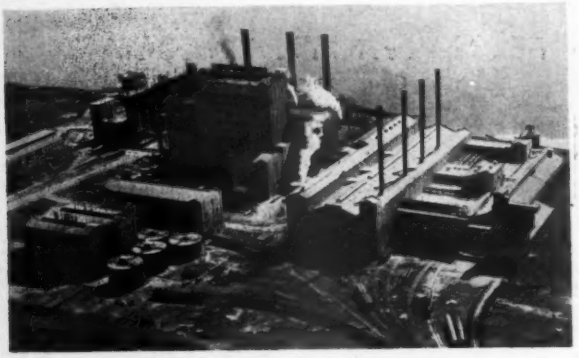
Milestones in Glass Progress

PHOTO COURTESY THE CORNING MUSEUM OF GLASS

1760 Above is one of the only known pair of goblets bearing the signature of William Beilby of Newcastle. The foremost 18th-century English enameler, Beilby specialized in enameling goblets and wine glasses with coats of arms in faultless heraldic colors —was commissioned to reproduce the Royal Arms commemorating the birth of George IV in 1762.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (North Plant, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

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